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FAO
TECHNICAL
GUIDELINES FOR
RESPONSIBLE
FISHERIES

4

Suppl. 3

# FISHERIES MANAGEMENT

## 3. Managing fishing capacity

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*Cover photo:*
Boats moored at El Jadida fishing port, Morocco. FAO/21916/G. Bizzarri.

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FAO TECHNICAL GUIDELINES FOR RESPONSIBLE FISHERIES

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# FISHERIES MANAGEMENT

## 3. Managing fishing capacity

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
Rome, 2008

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## PREPARATION OF THIS DOCUMENT

These Guidelines on managing fishing capacity have been finalized by the FAO Fisheries and Aquaculture Economics and Policy Division based on a number of studies and technical documents produced by the Division. In many cases, parts of these Guidelines have been directly taken from existing FAO reports and documents. Key authors of the reports used in this compilation include (in alphabetical order) Steve Cunningham, David Doulman, John Gates, Dominique Gréboval, Angel Gumy, Jim Kirkley, Rebecca Metzner, Sean Pascoe, Ross Shotton, Dale Squires, John Ward and Lena Westlund. The report also draws on papers presented at a number of expert consultations, technical working group meetings and workshops. The final draft was prepared by Sean Pascoe, Dominique Gréboval and Rebecca Metzner.

These Guidelines have no formal legal status. They are intended to provide support for the implementation of the Code of Conduct for Responsible Fisheries ("the Code" or CCRF). Furthermore, in order to present the management process in all its complexity and diversity, the wording and structure of these Guidelines do not follow strictly the language and the structure of the Code. Therefore, any differences in the terminology employed should not be understood as intending reinterpretation of the Code.

Finally, it should be remembered that, since the Guidelines are intended to be flexible and capable of evolving as circumstances change, or as new information becomes available, they may be further revised and complemented by other guidelines, notes, etc., on specific issues.

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## ABSTRACT

Overcapacity is a key factor contributing to the decline in many of the world's fisheries. The FAO International Plan of Action for the Management of Fishing Capacity (IPOA-Capacity) encourages States to address this problem through capacity management in order to align fishing capacity with the sustainable use of their fish stocks.

The purpose of these Guidelines is to aid stakeholders and fisheries managers in the development of National and Regional Plans of Action for the Management of Fishing Capacity.

The Guidelines provide information of the effects of different management programmes on capacity and outline the key concepts and techniques involved in monitoring, measuring and assessing capacity. The Guidelines also outline actions of States in conformance with the IPOA-Capacity.

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**Acronyms and abbreviations**

| | |
|---|---|
| APEC | Asia-Pacific Economic Cooperation |
| ASEAN | Association of Southeast Asian Nations |
| CCRF | Code of Conduct for Responsible Fisheries |
| CDQ | community development quota |
| CFQ | community fishing quota |
| COFI | FAO Committee on Fisheries |
| CPUE | catch per unit effort |
| CST | customary sea tenure |
| DAPP | designated access privilege program |
| DEA | data envelopment analysis |
| EEZ | exclusive economic zone |
| FAD | fish aggregating device |
| GATT | General Agreement on Tariffs and Trade |
| GRF | group rights in fisheries |
| IEQ | individual effort quota |
| IFQ | individual fishing quota |
| IPOA | international plan of action |
| ITE | individual transferable effort |
| ITQ | individual transferable quota |
| IUU | illegal, unreported and unregulated (fishing) |
| MEABR | management and exploitation areas for benthic resources |
| MEY | maximum economic yield |
| MSY | maximum sustainable yield |
| NEAFC | Northeast Atlantic Fisheries Commission |
| NPOA | national plan of action |
| OA | open access |
| OECD | Organisation for Economic Co-operation and Development |
| RFMO | regional fisheries management organization |
| SPF | stochastic production frontiers |
| TAC | total allowable catch |
| TURF | territorial use right |
| UNCLOS | United Nations Convention on the Law of the Sea of 10 December 1982 |
| WSSD | World Summit on Sustainable Development |
| WTO | World Trade Organization |
| WTO–CTE | World Trade Organization Committee on Trade and Environment |

## BACKGROUND

1. From ancient times, fishing has been a major source of food for humanity and a provider of employment and economic benefits to those engaged in this activity. However, with increased knowledge and the dynamic development of fisheries, it has been realized that living aquatic resources, although renewable, are not infinite and need to be properly managed if their contribution to the nutritional, economic and social well being of the growing world's population is to be sustained.

2. The adoption in 1982 of the United Nations Convention on the Law of the Sea provided a new framework for the better management of marine resources. The new legal regime of the oceans gave coastal States rights and responsibilities for the management and use of fishery resources within the area of their national jurisdiction (EEZs), which embrace some 90 percent of the world's marine fisheries.

3. In recent years, world fisheries have become a dynamically developing sector of the food industry, and many States have striven to take advantage of their new opportunities by investing in modern fishing fleets and processing factories in response to growing international demand for fish and fishery products. It has since become clear, however, that many fisheries resources cannot sustain an often uncontrolled increase of exploitation.

4. Clear signs of over-exploitation of important fish stocks, modifications of ecosystems, significant economic losses, and international conflicts on management and fish trade have threatened the long-term sustainability of fisheries and the contribution of fisheries to food supply. Therefore, the Nineteenth Session of the FAO Committee on Fisheries (COFI), held in March 1991, recommended that new approaches to fisheries management embracing conservation, environmental, social and economic considerations were urgently needed. FAO was asked to develop the concept of responsible fisheries and elaborate a Code of Conduct to foster its application.

5. Subsequently, the Government of Mexico, in collaboration with FAO, organized an International Conference on Responsible Fishing in Cancun in May 1992. The Declaration of Cancun endorsed at that conference was brought to the attention of the UNCED Summit in Rio de Janeiro, Brazil, in June 1992, which supported the preparation of a Code of Conduct for Responsible Fisheries. The FAO Technical Consultation on High Seas Fishing, held in September 1992, further recommended the elaboration of a Code to address the issues regarding high seas fisheries.

6. The One Hundred and Second Session of the FAO Council, held in November 1992, discussed the elaboration of a Code, recommending that priority be given to high seas issues and requested that proposals for a Code be presented to the 1993 session of the Committee on Fisheries.

7. The Twentieth Session of COFI, held in March 1993, examined in general the proposed framework and content for such a Code, including the elaboration of guidelines, and endorsed a time frame for the further elaboration of the Code. It also requested FAO to prepare, on a "fast track" basis, as part of the Code, proposals to prevent re-flagging of fishing vessels which affect conservation and management measures on the high seas. This resulted in the FAO Conference, at its Twenty-seventh Session in November 1993, adopting the Agreement to Promote Compliance with International Conservation and Management Measures by Fishing Vessels on the High Seas, which, according to FAO Conference Resolution 15/93, forms an integral part of the Code of Conduct for Responsible Fisheries (CCRF).

8. The Code was formulated so as to be interpreted and applied in conformity with the relevant rules of international law, as reflected in the United Nations Convention on the Law of the Sea of 10 December 1982 (UNCLOS), as well as with the Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 Relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks, 1995, and in the light of, *inter alia*, the 1992 Declaration of Cancun, the 1992 Rio Declaration on Environment and Development, and in particular, Chapter 17 of Agenda 21.

9. The development of the Code was carried out by FAO in consultation and collaboration with relevant United Nations Agencies and other international organizations, including non-governmental organizations.

10. The Code of Conduct consists of five introductory Articles: Nature and Scope; Objectives; Relationship with Other International Instruments; Implementation, Monitoring and Updating and Special Requirements of Developing Countries. These introductory articles are followed by an article on General Principles, which precedes the six thematic articles on Fisheries Management, Fishing Operations, Aquaculture Development, Integration of Fisheries into Coastal Area Management, Post-Harvest Practices and Trade, and Fisheries Research. In addition and as already mentioned, the Agreement to Promote Compliance with International Conservation and Management Measures by Fishing Vessels on the High Seas forms an integral part of the Code.

11. The Code is voluntary. However, certain parts of it are based on relevant rules of international law, as reflected in the UNCLOS. The Code also contains provisions that may be or have already been given binding effect by means of other obligatory legal instruments amongst the Parties, such as the Agreement to Promote Compliance with International Conservation and Management Measures by Fishing Vessels on the High Seas.

12. The Twenty-eighth Session of the Conference in Resolution 4/95 adopted the Code of Conduct for Responsible Fisheries on 31 October 1995. The same Resolution requested FAO, *inter alia,* to elaborate as appropriate Technical Guidelines in support of the implementation of the Code in collaboration with members and interested relevant organizations.

13. This volume is the third supplement in the series of FAO Technical Guidelines for Responsible Fisheries. Fisheries management (No. 4).

# 1. INTRODUCTION

## 1.1 Overexploitation in world fisheries

Fishing is an economic activity. Fishing effort is targeted towards species that have a value to consumers (represented by the price consumers are willing to pay), and fishers develop specialist fishing gears (e.g. fish traps, prawn trawls, scallop dredges, lobster pots) to target the most valuable species. The development and adoption of new technologies and increases in average boat size and/or power are direct consequences of fishers' desire to increase the profitability of their activities.

A long-term and critical consequence of this economic activity has been, perversely, a reduction in the potential yields that can be achieved from fish stocks and the dissipation of potential economic benefits that fisheries could produce. Excessive levels of fishing capacity and overcapacity affect many domestic fisheries throughout the world and, in an even more pervasive form, many high-seas fisheries. The globalization of the phenomenon is illustrated by the relative stagnation of world marine catches of major species since the late 1980s. Evidence provided by FAO (2006) indicates that, in reference to all major marine fisheries, 25 percent are subjected to severe overfishing while a further 52 percent are fully exploited. Demersal and other highly valued stocks are generally the most affected.

Fisheries management has been introduced in some form in most countries in an attempt to either limit further overfishing and resource degradation or aid in the recovery of depleted stocks. A recent survey of FAO Member States (FAO, 2004a) found that 90 percent of respondents had introduced at least some form of regulated access to their fisheries resources. A typical main objective in most fisheries management plans is the conservation of fisheries resources, although social and economic factors are also often considered when developing management targets. However, economic considerations have largely been limited to mitigate short term regional economic impacts of effort reduction (employment, in particular) and, as such, are often been used as a reason to moderate effort or catch reductions proposed by fisheries scientists.

## 1.2 The International Plan of Action for the Management of Fishing Capacity (IPOA-Capacity)

The issue of managing fishing capacity has been raised relatively recently in reference to growing concern about the spreading phenomenon of excessive fishing inputs and overcapitalization in the world's fisheries. The issue is essentially one of having too many vessels or excessive harvesting power in

a growing number of fisheries. The existence of overcapacity is largely responsible for overfishing, for the dissipation of food production potential and for significant economic waste. Overcapacity manifests itself especially in the form of redundant fishing inputs and the overfishing of most valued fish stocks.

At the global level, overcapacity in world marine fisheries appears to be a relatively new phenomenon, dating from the late 1980s and following a decade of very intense fleet development. FAO data indicate that nominal fleet size seems to have peaked during the mid-1990s. However, actual fishing capacity may still be increasing due to technological development and the refitting of older vessels.

Essentially, the existence of overcapacity is a result of the widespread tendency to over invest and overfish under open access conditions. Overcapacity in world fisheries has also came about progressively as a result of broader and related factors, such as the:

- resilient profitability of fishing activities, whereby technical progress and relative price inelasticity of demand for fish have largely compensated for diminishing yields in overfished fisheries;
- effect of the extension of maritime areas under national jurisdiction on private and public investment strategies and of related "nationalization" policies, generally accompanied by sizable fishing subsidization programmes;
- relative mobility of harvesting capacity, which has allowed for a pervasive spillover of excess capital among fisheries, both within areas under national jurisdiction and on the high seas;
- changing nature of the industry, which is increasingly competitive and capital-intensive, with markets that are now largely based on internationally traded commodities; and above all,
- failure of fisheries management (in general) and of commonly used management methods (in particular) such as catch (total allowable catch or TAC), gear and spatial and temporal restrictions – which aim essentially at controlling fishing mortality indirectly through regulating the catching activities – rather than aiming to directly address the reasons why fishers are motivated to invest in excessive capital and capacity.

The FAO Code of Conduct for Responsible Fisheries (CCRF) recognized that excessive fishing capacity threatens the world's fishery resources and their ability to provide sustainable catches and benefits to fishers and

consumers. In Article 6.3, it is recommended that "*States should prevent overfishing and excess fishing capacity and should implement management measures to ensure that fishing effort is commensurate with the productive capacity of the fishery resources and their sustainable utilization*".

In 1997, the FAO Committee on Fisheries (COFI) recommended that a technical consultation be organized by FAO to clarify issues related to overcapacity in fisheries and to prepare Guidelines. Work undertaken by FAO on this basis (FAO, 1998b) led to the preparation of the FAO International Plan of Action for the Management of Fishing Capacity (IPOA-Capacity, reprinted in Appendix 1).

The IPOA-Capacity was adopted by COFI in February 1999, and further discussed by the FAO Ministerial Meeting on Fisheries in March 1999. The Ministers declared to "*attach high priority to the implementation of the International Plan of Action for the Management of Fishing Capacity ... and on putting into place within the framework of national plans, measures to achieve a balance between harvesting capacity and available fisheries resources.*"[1]

The IPOA-Capacity was elaborated within the framework of the CCRF as an element of fisheries conservation and sustainable management. The immediate objective of the IPOA-Capacity is for "*States and regional fishery organizations, in the framework of their respective competencies and consistent with international law, to achieve worldwide preferably by 2003 but no later than 2005, an efficient, equitable and transparent management of fishing capacity*". The IPOA-Capacity further specifies that, *inter alia*, States and regional fishery organizations, when confronted with an overcapacity problem which undermines the achievement of long-term sustainability outcomes, should endeavor to limit initially at existing level and progressively reduce the fishing capacity applied to affected fisheries. On the other hand, where long-term sustainability outcomes are being achieved, it nevertheless urges States and regional fishery organizations to exercise caution.

The IPOA-Capacity is voluntary, and is based on a number of major principles of the CCRF as well as on complementary principles. These include:

- a three-phase implementation: i) assessment and diagnosis; ii) adoption of preliminary management measures; and iii) a system

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[1] The Rome Declaration on the Implementation of the Code of Conduct for Responsible Fisheries. Adopted by the FAO Ministerial Meeting on Fisheries. Rome, 10–11 March 1999.

of periodic reviews and adjustments; with priority being given to managing fishing capacity where it results in unequivocal overfishing; and

- a holistic approach by which the management of capacity should consider all factors affecting capacity in national and international waters, further recognizing the need to properly account for mobility and evolving technologies.

The IPOA-Capacity specifies a number of actions to be taken urgently. Major actions are prescribed in reference to the main section of the document: assessment and monitoring of fishing capacity, the preparation and implementation of national plans, international consideration and immediate actions for major international fisheries requiring urgent attention.

Regarding the assessment and monitoring of fishing capacity, the IPOA-Capacity recommends, *inter alia*, that States:

- support coordinated efforts and research to better understand the fundamental issues related to the measurement and monitoring of fishing capacity;
- proceed by the end of 2000 with preliminary assessment of fishing capacity and with the systematic identification of fisheries requiring urgent attention at national, regional and, in collaboration with FAO, at global levels; and
- develop appropriate records of fishing vessels and support the establishment by FAO of an international record of vessels operating on the high seas.

### 1.3 Objectives of these Guidelines

These Guidelines have been produced to support implementation of the IPOA-Capacity by national governments as well as by relevant international organizations, particularly at the regional and subregional level. They are intended to provide guidance for States and regional organizations as to how to proceed in the development of capacity management plans.

These Guidelines review the problems associated with overcapacity, factors contributing to the development of overcapacity, methods for determining the level of overcapacity in national and international fisheries, and mechanisms to reduce overcapacity. The information is derived from a number of studies undertaken by FAO, a list of which is provided in Appendix 2, and States may find it useful to familiarize themselves with

these supporting documents. These Guidelines should also be read in conjunction with the FAO Technical Guidelines for Responsible Fisheries, No. 4: *Fisheries management* and the FAO Technical Guidelines for Responsible Fisheries, No. 9: *Implementation of the International Plan of Action to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated (IUU) Fishing*.

These Guidelines are not intended to be a substitute for the IPOA-Capacity itself, or as a manual for interpretation or application of other relevant instruments in the field of international fisheries; moreover, these Guidelines have no formal legal status.

## 2. BASIC CONCEPTS

### 2.1 Why look at capacity?

The need for fisheries management, and the consequences of permitting fisheries to remain unregulated, has been well established. States have a responsibility to manage their fishery resources in their exclusive economic zones (EEZs) under the United Nations Convention on the Law of the Sea of 10 December 1982 (UNCLOS). In response, most States impose target restrictions on catches in key offshore fisheries – either explicitly through output controls or implicitly through input controls. Many inshore small scale and artisanal fisheries, however, remain relatively unregulated, while fishing outside EEZs (i.e. in international waters) also remains largely unregulated. The consequences of overcapacity to a State can be substantial, both in the short term as well as in the longer term (Figure 1) because there will be consequences in terms of IUU fishing, politics, society, and economics (in addition to the biological ones).

Even where fisheries management restrictions have been imposed in offshore fisheries, imbalances have arisen between the ability of the fleet to harvest the resource and the ability of the resource to regenerate. Similarly, the capacity of inshore and high seas fleets thus also increased beyond the ability of the resource to sustain itself. The *Environmental Agenda for the 21st Century* (Agenda 21) arising from the 1992 Green Summit in Rio de Janeiro identified global fishing capacity levels as an international fisheries management problem and included a call for governments to cooperate in addressing this crisis in global fisheries.

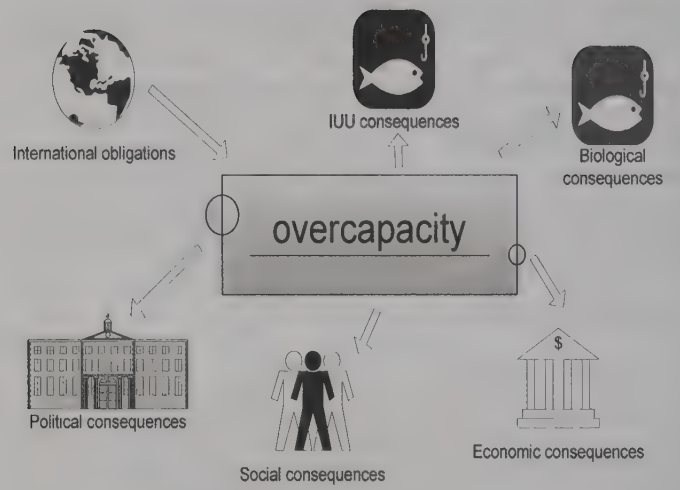


**Figure 1. Why look at overcapacity?**

As a result of a series of negotiations begun in 1993, three international agreements were completed: (1) the FAO CCRF, (2) the Agreement to Promote Compliance with International Conservation and Management Measures by Fishing Vessels on the High Seas (Compliance Agreement), and (3) the Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks (Fish Stocks Agreement). These agreements impose obligations on States to consider the management of fishing capacity as part of their fisheries management system.

Notwithstanding the international obligations to consider capacity in the development of fisheries management plans, States will benefit from considering correcting any imbalances between fishing fleet capacity and the sustainable use of fisheries resources.

### *2.1.1 International responsibilities*

As mentioned in the introduction, the CCRF recognizes that overcapacity is a major impediment to sustainable fishing and calls on States to take action in this regard. Paragraph 6.3 of the CCRF recommends that "*States should*

*prevent overfishing and excess fishing capacity and should implement management measures to ensure that fishing effort is commensurate with the productive capacity of the fishery resource and their sustainable utilization."* Further, paragraph 7.1.8 of the CCRF states that "*States should take measures to prevent or eliminate excess fishing capacity and should ensure that levels of fishing effort are commensurate with the sustainable use of fishery resources as a means of ensuring the effectiveness of conservation and management measures"* (FAO, 1995). In addition, the IPOA-Capacity also urges Member States to measure, assess, and manage fishing capacity. These suggestions, along with guidance as to how they may be realized, are detailed in subsequent sections of these Guidelines.

For high seas fisheries, which are outside the jurisdiction of individual Member States, ratification of the Compliance Agreement by all contracting States will help reduce capacity problems. For these and other shared bodies of water, regional fisheries management organizations (RFMOs) will play a major role in assisting in this regard. Hence, Member States are encouraged to familiarize themselves with the responsibilities described in the Code, these agreements and various plans of action.

### *2.1.2 Biological consequences of overcapacity*

Excessive levels of fishing effort associated with overcapacity result in a gradual decline in the size of the stocks. As a consequence, yields decline to below maximum sustainable yield (MSY). In some circumstances, excessive effort levels can cause reductions in fish stocks to levels where they are threatened with extinction. This is particularly the case if advances in fishing technology or increases in the price paid for fish offset the effects of reduced stock size in the production process, so that it is still profitable to harvest species at very low stock levels.

Increased incidental catch (i.e. bycatch) of non-target species and habitat destruction directly results from the excessive levels of fishing effort in fisheries characterized by overcapacity. In addition, as fishermen work harder to compensate for deleted stocks, they may deploy excessive amounts of fishing gear in sensitive ecological areas, further reducing the carrying capacity of the environment for fish species.

### *2.1.3 Economic consequences*

Overcapacity typically results in overexploitation of resources and the inefficient use of the resource, capital stock, and all productive factors involved in the fishing activity. From an economic viewpoint, the same – if not greater – catches could be taken using fewer inputs and, consequently, at a lower cost. Alternatively, a smaller fleet could land the same level of catch at a substantially reduced cost.

These cost savings arise through two mechanisms. Firstly, a reduced number of vessels results in reduced fixed and capital costs being incurred unnecessarily. Second, if overfishing is stopped and the stock can recover, a larger resource stock and resultant higher catch rates decrease the cost per unit catch. Reducing economic waste also generates additional profits, which can be used to benefit the entire community.

Overcapacity also imposes additional costs on the harvesting process. With excessive effort, congestion and crowding can reduce catch rates as fishing grounds are repeatedly exploited. This reduces the revenue of the participating boats and fishermen and increases the cost per unit catch.

### *2.1.4 Links to IUU fishing*

The existence of overcapacity has an impact on the level of IUU fishing because the overfishing that results directly from overcapacity in turn may lead to IUU fishing. For this reason, fisheries management and capacity controls must consider how they will inspire or deter IUU fishing.

In fisheries managed through total allowable catches, the existence of overcapacity can increase the incentives to land fish illegally as vessels may not be financially viable without the additional income from illegal landings, but such unreported catch, sold though the black markets, does not get taken into consideration in subsequent stock assessments. Overcapacity in regulated fisheries may also result in effort being displaced into unregulated fisheries (either within or outside the EEZ), or even the re-flagging of vessels so that the boats can operate into other fisheries that are unmanaged or poorly managed.

### *2.1.5 Social and political consequences*

Declines in stock abundance as a result of overcapacity and, consequently, declines in fishing income, will have an impact not only on the fishers themselves, but also other sectors in the local economy that service the industry directly (e.g. fuel suppliers, boatyards) and indirectly (e.g. local stores the provide consumer goods to the fishers and their families). This is particularly of concern in areas dependent on the fishing sector as a major source of income, as are many small coastal communities.

Overcapacity can also have political consequences. Poor economic performance in a fishery sector as a result of overcapacity can lead fishermen to call for subsidies and other forms of assistance. Failure to provide such assistance may result in poverty and hardship in key constituencies; yet, providing support may result in conflicts with other industries (who may also then call for assistance), violation of international treaties (e.g. the General Agreement on Tariffs and Trade [GATT]), as well

as exacerbating the overcapacity problem. Conflicts between competing users of the resource may also increase, with subsequent increased pressure for greater intervention by different stakeholder groups.

## 2.2 Definitions of key concepts

### *2.2.1 Capacity versus capacity utilization*

A main factor contributing to the confusion about capacity in fisheries is that different groups have different concepts of capacity. Understanding these different perceptions will assist different stakeholders in communication something that is essential for the development of effective capacity management plans.

Fisheries scientists often think of capacity in terms of fishing effort, and the resultant rate of fishing mortality (the proportion of the fish stock killed through fishing). Effort is itself a fairly abstract concept as, in theory, it encapsulates all inputs employed in the harvesting process. In practice, it is generally not possible to measure all inputs, so proxy measures are used such as the total days fished, the number of pots or kilometers of nets deployed. Next, it is assumed that a relationship between the measure of effort and fishing mortality exists. If total fishing mortality exceeds the desired target level (generally a biological reference point relating to maximum sustainable yield or some other precautionary reference point), the fishing mortality rate is described as too high because fishers have produced too much fishing effort. Thus, from this perspective, if regulations can be imposed to ensure that effort levels are in line with target fishing mortality rates, then capacity is not considered an issue.

Fisheries managers generally have a similar view of capacity, but they often link the concepts of capacity and overcapacity more directly to the number of fishing boats in a fishery. This view is particularly prevalent where the fishery is managed though the use of input controls, because fleet size and effort levels are then the main control variables. Fisheries managers generally consider capacity to relate to measures such as gross tonnage, for example, and will then represent total effort as the particular capacity measure multiplied by the number of days fished per vessel aggregated over the fleet. In terms of meeting stock conservation goals, this may be problematic because too many boats may potentially produce too high a catch even if individual effort levels are restricted, and overcapacity will exist if the fleet is larger than desired.

In contrast, economists tend to consider capacity as some level of potential output that could be produced if the boat was operating at maximum profits. Operating at less than full capacity implies, therefore, that the boats are not

achieving their maximum profits, and that profits could be increased through increasing their output. Associated with this profit maximizing level of activity would be a nominal level of fishing effort (e.g. days fished). As a result, the full use level of catch and fishing effort from an economic perspective may be less than is actually possible for a boat to achieve or less than its expected 'normal' number of fishing days. This is a more directly observable indicator than potential output (which needs to be estimated), although the link between days fished and the capacity level of output is not necessarily linear.

FAO (2000a) suggested that capacity may be defined with reference either to fishing inputs (vessels, potential effort) or to fishing output (potential catch) and uses the general definition:

> *Fishing capacity is, for a given resource condition, the amount of fish (or fishing effort) that can be produced over a period of time (e.g. a year) by a vessel or a fleet if fully utilized. That is, if effort and catch were not constrained by restrictive management measures.*

The phrase "full utilization" in this sense means normal, but unrestricted use rather than maximum use. In contrast, "current capacity utilization", given as observed activity divided by potential activity, will be less than 1 and may be expressed in percentage terms, as is usually done for other industries.

For example, a vessel may operate in a fishery that is open for 365 days a year, but would normally be expected to operate for, on average, 260 fishing days per year in the absence of restrictions. The vessel is unable to operate every day for a number of reasons that are not due to management restrictions. These might include factors such as markets being closed on weekends (so no point in fishing if there is no market to supply), breakdowns, annual repairs and maintenance and availability of the crew (who would also appreciate some time off over the year). As a result, 260 days may be considered the full capacity level of activity. In terms of output, the catch that could be expected from operating for 260 days would be the capacity output. If the vessel *actually* only operated for 180 fishing days, e.g. as a result of effort or catch quotas being imposed, then the vessel's capacity would be underutilized. For this particular example, the vessel is observed to be operating at 70 percent capacity utilization under normal, unrestricted use.

In terms of output measures of capacity, the vessel might be expected to catch 100 tonnes under normal operating conditions. However, as it is fishing less than it would normally be expected to, it might only have

caught 70 tonnes. Again, capacity utilization can be measured as the observed catch over the potential (full capacity) catch, giving a capacity utilization rate of 70 percent. In general, capacity utilization based on fishing effort measures would not necessarily be the same as that derived from output measures of capacity unless catch rates were constant over the fishing year.[2]

For the purposes of developing a National Plan of Action for the Management of Fishing Capacity (NPOA-Capacity), States should adopt a national definition of fishing capacity. The 1999 FAO Technical Consultation on the Measurement of Fishing Capacity recognized that capacity can be estimated either on an input or output basis. For the purpose of international comparison, however, it was recommended that States express their national estimates on both bases, removing the need to agree on a common definition when the management of fishing capacity involves international cooperation.

### *2.2.2 Excess capacity versus overcapacity*

The existence of underutilized capacity is an indication that *excess capacity* exists in a fishery, and that fewer boats, if fully utilized, could potentially have caught the same total catch. Excess capacity is a short run phenomenon and depends on the state of the resource and the environment (natural, social and economic) in which the fishers operate. A fishery with a fluctuating stock may exhibit excess capacity in some years and full capacity in others. Similarly, if market conditions are unfavourable, a fleet may exhibit excess capacity that disappears once prices return to their normal level. Yet, in spite of this temporary and changing excess capacity, overcapacity in the fishery may not exist.

*Overcapacity* is a longer-term problem and reflects a divergence between the resources used to harvest the resource (and the resultant current level of output) and the resources needed (and corresponding output) to harvest the resource at an "optimal" level. Optimal, in this sense, will largely be driven by the objectives of fisheries management, be they economic, social or conservation based (or some combination of all three). If the fishery is severely overexploited, this optimal yield may be higher than the current

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[2] In production theory, this is known as constant returns to fishing effort. Constant returns have been observed in many fisheries, but cannot be necessarily assumed. With highly seasonal fisheries, decreasing returns (i.e. catch rates decline with increasing effort) might be expected. Similarly, in highly congested fisheries (i.e. high levels of overcapacity), then decreasing returns are also more likely to be experienced. In such cases, effort based measures of capacity utilization may be lower than catch based measures.

catch level, but associated with a large biomass. The existence of underutilized capacity may be indicative of overcapacity, but it does not necessarily convey information about the extent of overcapacity. Conversely, with an overexploited stock, little excess capacity may be exist even though considerable overcapacity exists.

This difference can be highlighted in a simple example. In Figure 2, the fleet currently consists of $V_1$ number of vessels catching $C_1$ quantity of fish. At any one point in time, the fishery is operating on the short run yield curve, which is dependent on the size of the stock. Note that at this level of fishing intensity, the short run yield curve is above the long run yield curve, indicating that this level of yield is not sustainable.

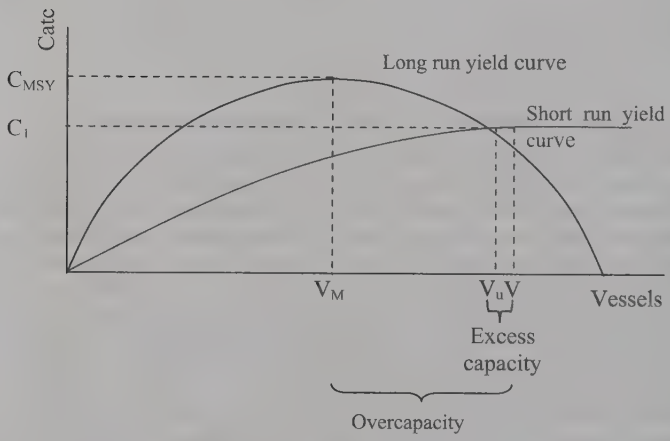


**Figure 2. Excess versus overcapacity**

Excess capacity exists in the fishery, as the same catch ($C_1$) could have been taken with fewer vessels, $V_u$, with all of these vessels now being fully utilized. Note also that even with $V_u$ vessels, however, $C_1$ is not a sustainable yield as the intersection with the short run yield curve is still above the long run yield curve.

If we assume that managers have an objective of achieving maximum sustainable yield ($C_{MSY}$), then the number of vessels would need to be

reduced even further to $V_{MSY}$. The difference between $V_1$ and $V_{MSY}$ represents the amount of overcapacity in the fishery.

The actual estimation of overcapacity from an output perspective is complex, as will be demonstrated in subsequent sections of the Guidelines. However, from an input perspective, overcapacity means that there are more boats in the fishery than are desirable in order to achieve long run sustainable target yields.

The focus of capacity management should be the elimination or reduction of overcapacity. This may also entail a reduction of excess capacity in the process (as would be the case in Figure 2).

### *2.2.3 Target capacity and overcapacity*

Central to the definition of overcapacity is the concept of *target capacity*. This is the level of either output or inputs that are required to meet the objectives of the fisheries management plan for the fishery in question.

For example, if the management objectives focused on maximizing the output from the fishery, then maximum sustainable yield (MSY) would be an appropriate target output capacity, and the fleet size required to achieve MSY would be an appropriate target input capacity. Conversely, if economic profitability was a consideration, the maximum economic yield (MEY) and the number of boats (the fleet level) associated with that would be considered an appropriate target capacity.

## 2.3 Causes of overcapacity

The fundamental origin of overcapacity in fisheries is the prevalence of free and open access to the resource. In addition, there are a number of other factors have also contributed to the development of overcapacity.

### *2.3.1 Access conditions*

In many cases, it is felt that the key issue in managing a fishery that requires attention is the conservation of the fish stock. Yet, with the benefit of hindsight, it is clear that another key management issue is to address the causes of overcapacity. Unless management systems are instituted which enable the overcapacity problem to be addressed, the management of a fishery is going to be a costly failure in the long term – even if the important, but limited, objective of conserving the fish stock might be achieved in the initial stage of development of a fishery.

The focus on conserving fish stocks has led many management authorities to move their fisheries from a condition described as of free and open access to one that can be characterized as regulated open access. Under such

a management structures, one or more elements of the fishery system are constrained (e.g. total catch under TAC systems or restrictions on the use of boats and gear) but fishers' access to the fishery remains free and open within the constraint.

The major instruments used to regulate open access do not address the management of fishing capacity itself, at least in any lasting way. Among these are TACs, mesh size and fish size restrictions, effort limitation, gear restriction, seasonal closures and other instruments basically aimed at preserving the productivity of the stock (e.g. protection of certain year classes and reproductive areas) or limiting the overall catch. The implementation of these instruments within the context of otherwise free and open access has no lasting impact on the flow of investment in the fisheries sector. Instead, in general, these measures motivate fishers to redistribute their fishing effort across fisheries or to modify their boats in ways that may result in an increase in fishing capacity.

From a pure stock conservation perspective, the existence of excessive levels of fishing effort does not pose any threat provided that the total output of the fishery is constrained to a sustainable level (e.g. through an enforced TAC system). However, the existence of excessive levels of capacity creates a number of economic problems, some of which may also have implications for the success of the stock conservation measures. These economic problems include incentives to exceed any quota imposed, to race to fish, and to increase capitalization in a bid to increase individual returns, and these generally make overcapacity problems worse as fishers respond to the constraint (e.g. by using larger boats under a TAC system).

In short, the development of overcapacity is the consequence of rational investment by fishers given the economic and other incentives that they face under free and open access and regulated open access to increase capacity beyond levels that are optimal for society as a whole. Hence, policy makers should recognize that overcapacity is an inevitable consequence of free and open access, and they need to address the management of fishing capacity in this context. An in-depth analysis of prevailing access conditions and alternatives options is thus an essential part of designing a policy for the management of fishing capacity.

### *2.3.2 Subsidies*

FAO brought the world's attention to fisheries subsidies as a stimulus to overcapacity and overfishing in 1992 when it published *Marine fisheries and the Law of the Sea: a decade of change* (FAO, 1992). Before and after the adoption of United Nations Convention of the Law of the Sea (UNCLOS) in 1982, many coastal countries implemented economic support

programmes to take full advantage of their recently acquired EEZs. Since then, the role of fishery subsidies has been receiving increasing attention both in governments and by civil society not only in relation to their potential distorting effects on fish trade but also in relation to their likely negative effects on the sustainability of fishery resources in the absence of effective fisheries management. This trend was substantially confirmed in 1997 when the WTO Committee on Trade and Environment (WTO-CTE) decided to include fisheries as one of the economic sectors that would be discussed by the Committee in the context of the environmental benefits of subsidy removal.

Increases in fishing capacity have often been a direct consequence of countries' national policies aimed specifically at developing their fisheries as referred before. A major policy instrument used in this context has been the provision of subsidies and other economic incentives used initially, in an implicit association with the enfant industry concept, to promote the development of national fleets so as to harvest resources that became available following the extension of maritime areas under national jurisdictions. At present, many developing countries, while agreeing to the need to work effectively towards reducing subsidies that affect the sustainability of fishery resources, emphasize that when appraising the role of subsidies in their fishery sectors, careful attention also needed to be given to their use as an instrument of economic policy aimed, among other objectives, at stimulating the sustainable growth of their national fishery sectors (FAO, 2003b).

Subsidies were also used to ensure national participation in selected shared and high seas fisheries, often with the objective of ensuring a lasting share of these fisheries. At present, the international community is developing joint efforts to improve fisheries governance in the high seas including the establishment of effective cooperative intergovernmental fisheries management mechanisms. In other cases, subsidies have included the cost of access fees to foreign EEZs, as well as grants to invest in larger more suitable distance water fishing. The role of subsidies in access agreements and their impact on the fish stocks of the host country and on its future fisheries sustainable development as an effect of the incoming additional fishing capacity has been thoroughly studied by many parties and new approaches are being discussed.

There is broad agreement that regardless of the definition used, subsidies can contribute, in the absence of effective fisheries management, to generate excessive levels of fishing effort and overcapacity, which will ultimately affect the sustainability of the fish stock.

### *2.3.3 Other contributing factors*

Overcapacity in world fisheries has also come about as a result of various factors that have influenced the profitability of fishing. Some are the result of the normal evolution of any industry, such as:

- the rapid expansion of fish markets which provides for relatively favourable market prices;
- the resilient profitability of the industry as a consequence of both technical progress and high demand, which has offered opportunities for the exploitation of new fisheries, but which has also prevented downward fleet adjustments in overfished fisheries.
- the globalization of markets for fish and fish products, so that they are subject to the forces of internationally traded commodities;
- the changing nature of the fishing industry, which is increasingly competitive and capital intensive;
- the rapid growth in harvesting technologies that enable vessels of similar size to catch several times what they would have caught 25 years ago.

## 2.4 The dynamic nature of fishing capacity

The management of fishing capacity is made more complex by its dynamic nature. Capacity and, particularly, its degree of utilization will vary in response to economic parameters (especially prices of inputs and outputs) and catch rates.

States need to recognize that fisheries cannot be managed in isolation. Restrictions in one fishery may have consequences for other fisheries as a result of capacity dynamics. Further, the level and utilization of capacity in fisheries needs regular re-assessment, as even relatively small improvements in fishers' efficiency can cumulate over time, resulting in overexploitation of the fisheries resource.

### *2.4.1 Fishing in multiple fisheries*

Many fishers exploit more than one fishery, making it difficult to define capacity with respect to one fishery alone. Instead, an attempt must be made to define "industries" (i.e. combinations of fisheries and the fleets which exploit them) and then to consider capacity at this level. Identifying optimal levels of capacity may be problematic because capacity for some fisheries may not be known and it may be difficult to predict fleet behaviour in terms of distribution between fisheries.

Where access is not controlled, movements between fisheries may be very swift and can cause the collapse of a number of fisheries. Yet, while mobility among fisheries can be high, the alternative use of fishing boats (malleability) is frequently quite limited. This often leads to excess boats being transferred to other countries' waters or, in the case of marine fisheries, to the high seas. Non-malleability is also reflected by the profile of the world's fishing fleet: with reduced investment, data on vessels over 100 tons indicated that the majority of the world's fishing fleet was over 20 years old in 1997 (Smith, 1999).

### *2.4.2 Investment and capital*

Investment in fishing technology and capital changes the relationship between the measurable, or readily observable, level of inputs (e.g. boats, days fished) and the level of outputs. As a result, an imbalance between the harvesting ability of the fleet and the resource may develop even though nominal units of capacity remain unchanged. While fishers' investment behaviour is largely driven by expectations of future profitability, fishers may invest in versatile vessels and equipment for a number of other reasons. These might include:

- in order to exploit a series of naturally-seasonal fisheries;
- in response to management (very short fishing seasons induce fishers to invest in capacity that can be used elsewhere during the closed season);
- as part of a risk-minimization strategy; or
- to allow for opportunistic behaviour (to the extent that the management system allows such behaviour).

Even small changes in technology incorporated through general maintenance (e.g. replacement of old search technology with more modern versions) can alter the relationship between fleets and the resource over a period of time. For example, even an annual increase in efficiency of 1 to 2 percent a year can cumulate substantially over time. A 2 percent annual increase in efficiency can compound into an 80 percent increase in effective effort over a 30-year period even though the nominal (observed) effort remains the same. Failure to take into account the cumulative effects of technology change may result in fisheries become overexploited despite attempts to limit fishing effort.

## 3. DEVELOPING A PLAN OF ACTION FOR MANAGING FISHING CAPACITY

Paragraph 19 of the IPOA-Capacity requests States to develop, implement and monitor national plans of action for managing fishing capacity. The purpose of a NPOA-Capacity is to develop a framework in which a State can assess the current state of its fisheries, identify targets, and identify mechanisms by which these targets can be achieved.[3]

The key function of an NPOA-Capacity (other than complying with the IPOA-Capacity) is to map out a strategy for addressing overcapacity in fisheries. This includes measure to prevent the development of overcapacity as well as measures to identify and reduce any overcapacity that may already exist in national fisheries.

The development of such a strategy first requires managers to review their objectives of managing their fisheries, i.e. to answer the question of what the State aims to achieve through the utilization of the fisheries resource. Second, it requires an assessment[4] of the condition of its fisheries to determine the extent to which these objectives are being achieved. Third, it requires that the measures to be employed to achieve the objectives be determined. Finally, additional research, data and training needs need to be identified to enable appropriate ongoing monitoring and assessment of capacity. An overview of the key components of an action plan is presented in Box 1.

For the purposes of reporting, these stages may be considered separate sections. However, in order to develop an appropriate strategy, they are interrelated. For example, the goals, assessment techniques and strategies will affect the research, training and data needs. The general interrelationship between the various steps and the respective processes is illustrated in Figure 3.

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[3] The IPOA-Capacity also encourages related mechanisms for regional fisheries organizations for improved management of fishing capacity at the regional and global levels. Thus, much of the discussion of this section applies to regional organizations.

[4] Such an assessment may be qualitative or quantitative.

**Box 1**
**Features of a good action plan**

An action plan could be considered a method or approach for implementing a suite of activities to address a certain situation or a particular problem. In developing an action plan, it is important to:

- specify clearly the nature and extent of the problem to be addressed and its environment;
- describe the actions to be taken to prevent or avert the problem;
- clarify the resources to be needed;
- assign responsibilities for undertaking actions;
- determine where and when the respective actions will be undertaken;
- ensure that actions are consistent with prevailing policy and legislation;
- cooperate internationally when addressing extraterritorial issues; and
- describe when periodic reviews will be undertaken to assess progress to determine whether the action plan is achieving its goals.

A good action plan should contain:

- goals and objectives;
- an assessment of the situation "on the ground";
- a set of actions to be undertaken;
- priorities;
- an indication of the human and financial resources required and how they would be sourced;
- responsibility for coordination, communication and decision-making;
- assignment of roles and responsibilities for key persons and/or institutions;
- establishment of timelines for major activities;
- specification of expected outcomes including "indicators" for each outcome;
- monitoring of implementation; and
- provisions for review and revision

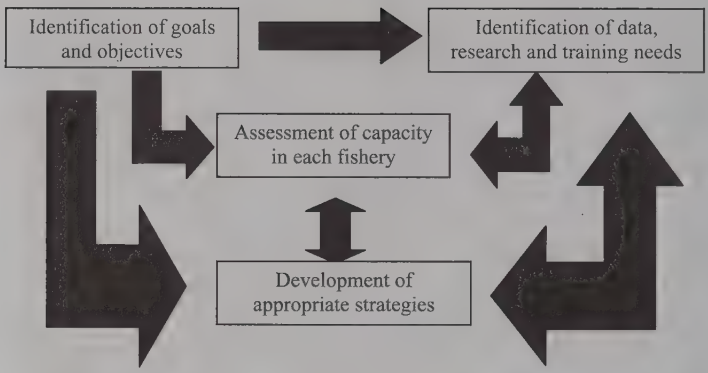
Identification of goals and objectives
Identification of data, research and training needs
Assessment of capacity in each fishery
Development of appropriate strategies

**Figure 3. Interrelationships between the stages of NPOA-Capacity development**

In many States, capacity management is part of the general fisheries management system (FAO, 2004a). In such cases, the development of a separate NPOA-Capacity may not be necessary, although States should identify in their general fisheries management plans how capacity has been taken into consideration (paragraph 23, IPOA-Capacity). Perhaps what is most apparent is that many of the considerations identified in Box 1 are equally relevant to fisheries management plans in general as well as capacity management plans.

### 3.1 Specification of objectives and goals of capacity management

The development of effective capacity management strategies requires the goals as well as objectives to be clearly identified. As noted previously, fisheries management is characterized by the existence of multiple objectives. These commonly include conservation, economic, and social objectives, but in some cases may also include other objectives such as generation of foreign exchange or food security.

As these objectives may conflict to some degree (e.g. employment and profitability objectives), managers and stakeholders need also to be able to clearly define the relative importance of each objective. For example, strong community employment objectives may result in a State strategy that favours inshore artisanal fleets over offshore industrial fleets, whereas profitability or foreign exchange objectives might result in a national

strategy that favours the offshore fleet. Similarly, a goal of eliminating overcapacity from selected fisheries may require different strategies to be applied to the different fisheries.

Related to the objectives of managing fishing capacity will be a set of goals for the fisheries that a State's capacity management strategy aims to achieve. For example, these may be to reduce overcapacity by a given proportion within a given timeframe (e.g. 25 percent over 5 years), or these may focus on eliminating overcapacity in particular fisheries. The identification of these goals will need to take into consideration a number of transitional factors (e.g. availability of alternative employment opportunities and the ability of fishers to change their livelihoods) and are discussed in further detail in Section 6.

The identification of objectives of capacity management, and fishery management in general, is essential for the determination of target capacity levels. Transparency in the process and definition of objectives of management, and also transparency in the relative importance of each objective, will help facilitate stakeholder involvement and "buy-in", as the rationale behind target capacity levels will be more apparent.

For this reason, the process of identifying and agreeing objectives for the fishery should also involve the key stakeholder groups that will be affected by the capacity management strategy. Different stakeholder groups often have different objectives, or different relative importance for each objective (Mardle, Pascoe and Herrero, 2004). In order to achieve maximum compliance and co-operation with the different stakeholders, it is important that goals and objectives for capacity management of each stakeholder group are identified, and the relative importance of each objective determined. The final set of objectives for capacity management needs to be determined through discussion with these groups and after compromises that are generally agreeable are developed.

When developing objectives and goals for capacity management, States also need to take into consideration the requirements of key international agreements, such as those embodied in the CCRF and the Compliance Agreement. These requirements should also be included in discussions with stakeholders to ensure that the final objectives for managing fishing capacity concur with international obligations.

### 3.2 Stakeholder engagement

Stakeholders have a role to play in the formulation of an NPOA-Capacity and capacity management plans, in the determination of management objectives, targets and goals and in the implementation of capacity

management plans. And, whilst several models of stakeholder engagement exist, from simple meetings to discuss proposals (generally termed consultation) through to stakeholder participation in the full management process (i.e. co-management), the choice of model adopted will depend on the individual circumstances of the State.

As a general principle, States are encouraged to develop mechanisms to enhance stakeholder engagement at every level, and the development of an NPOA-Capacity should involve stakeholder engagement (including non-fishery as well as fishery-related interest groups) at every stage. For example, non-fishing businesses in regions heavily dependent on fishing will be affected by capacity management and will have an interest in any management plans that affect the level of regional economic activity. Similarly, conservation groups may benefit from capacity reduction programmes and can work with the fishing community to help create win-win outcomes for all involved.

As noted previously, the processes of setting the overarching objectives of a NPOA-Capacity as well as the objectives of capacity management plans for specific fisheries should be undertaken in collaboration with stakeholder groups, each of whom may have different objectives and/or priorities. Failure to recognize and, where possible, reconcile these differences will result in poor compliance with any action plan that is eventually developed. As noted in FAO Technical Guidelines for Responsible Fisheries No. 4: *Fisheries management*, management should be seen as a partnership between the management authority and the different interest groups.

Similarly, the choice of management instrument used to achieve capacity management objectives should be determined in consultation with those most likely to be affected. The fishermen, both in particular fisheries and in the overall sector, and other stakeholders have considerable knowledge about the functioning of the fishery, and in many cases of the resource itself. As well as improving compliance, stakeholder knowledge may prove useful in determining the best instrument to adopt as the practical feasibility can be assessed. Similarly, expert knowledge harnessed through stakeholder engagement may be useful in identifying capacity targets, as will be discussed in the following section.

The potential role that stakeholders can play – particularly the fishing industry itself – is identified in further detail in latter sections of these Guidelines.

### 3.3 Assessment of target and current capacity

An NPOA-Capacity should call for an assessment of the current and desired (i.e. target) capacity in each fishery and fleet segment, and this may be included with general stock assessments and analyses of economic performance. (Even where capacity management is embedded in general fisheries management, it may be worthwhile to undertake periodic assessments.)

Target levels and current capacity need to be set and assessed, respectively, for each fishery because the problems of overcapacity will likely vary from fishery to fishery. Substantial overcapacity in one fishery may result in problems in other fisheries if capacity is transferred, but these potential problems will not be apparent from aggregated (national-level) assessment.

The target capacity is linked to the management objectives for the fishery. As these objectives may vary from fishery to fishery, the basis by which target capacity is determined may also vary. Target capacity may be estimated either analytically (i.e. using models that take into account the multi-objectives of management) or, more qualitatively, through the use of expert- and stakeholder-derived opinion when data are not sufficient to derive more objective measures.

Determining target capacity may require both quantitative and qualitative analysis. While target catches can be derived based on stock assessments, in multispecies fisheries exploited by several different fleet types, relating these to target fleet sizes is complex. Final target capacity measures may require a combination of quantitative analysis and expert opinion based on the available qualitative indicators.

The assessment of the current level of capacity should include, where feasible, both a qualitative and quantitative review of capacity in the fisheries. These are described in further detail in Section 4. An advantage of a quantitative review is that it provides immediate information on the extent of any capacity reduction that may be necessary.[5] However, quantitative measures of capacity are not necessarily straightforward, may be time consuming, and expensive, even when expressed in terms of inputs (e.g. number of vessels). Even when information on boat numbers is known, heterogeneity in vessels in terms of engine power, vessel size, fishing gear and technology within a fishery make simple estimates (i.e. total vessel numbers) unreliable. Moreover, as noted previously, fishers may operate in

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[5] For example, if the current capacity of a fishery was found to be 20 percent greater than the target capacity, then managers know that the goal of the capacity management strategy for that fishery is to reduce capacity by 20 percent.

several fisheries, making quantitative estimation of capacity more complex. Similarly, the existence of recreational, part time or subsistence fishers causes additional complications when estimating capacity in terms of inputs. Output oriented measures of capacity overcome some of these problems, but require detailed information that may not always be available.

Given these problems, qualitative indicators should also be used when assessing capacity in the fishery. A number of qualitative indicators are presented in Section 4. These include, but are not limited to, expert opinion on the state of the stocks, trends in catch per unit effort, levels of conflicts within the fishery, season length, and unutilized fishing licenses.

### 3.4 Management instruments and actions to achieve target capacity

An NPOA-Capacity should identify the management measures that will be introduced to achieve target capacities in fisheries. There is a range of management instruments available, a summary of these is presented in Section 5 and Appendix 3. An NPOA-Capacity should identify which management instruments are to be employed, and how they are to be implemented, including annual goals in terms of capacity reduction for each fishery, budgetary allocations (if required), and a timetable of actions to achieve the goals (e.g. the timing of buy-back schemes and/or the introduction of different regulations).

Capacity management measures – like all other fisheries management measures – need to take into consideration the overall objectives of management as well as the institutional capacity to implement them. Different instruments require different enforcement and monitoring needs, and introducing management measures that do not have the general acceptance of the participants in a particular fishery and that cannot be enforced will result in failure of the fishery to achieve its target capacity levels. An NPOA-Capacity, therefore, should also specify how and by whom both the NPOA-Capacity and also fishery-specific plans are to be monitored and enforced.

An NPOA-Capacity should also identify how the State has taken into account a range of transitional considerations, identified in Section 6. Failure to take these factors into consideration when designing a capacity reduction programme may result in a failure of the programme to achieve its target, or may result in other undesirable outcomes (social, economic or biological).

### 3.5 Monitoring and data requirements

Along with the standard monitoring arrangements that are associated with various types of fisheries management systems, fishing capacity management does have its own independent data and monitoring needs such as the systematic collection of catch and fleet (boat) data. This is in order to derive appropriate measures of both current and target fishing capacity.

In some cases, management instruments may reduce the effectiveness of some forms of data collection. For example, individual-based quota systems are often believed to reduce the reliability of logbook information unless fishers are convinced that sufficient surveillance and enforcement measures complemented by stringent penalties are also implemented. Moreover, managers need to assess their data needs for the purposes of both monitoring progress in the implementation of capacity management plans as well as providing sufficient information for future planning in the fishery.

Historically, most countries have developed monitoring systems and complementary research facilities that emphasize improved knowledge of catches and the status of the resource base. Output is generally monitored on a systematic basis in most countries, at least as far as landings are concerned, and this is useful to have because output-based management does require greater adherence to allowed vessel landings and catches and allows for the monitoring of discards and bycatch.

If management of fishing capacity is attempted using input controls, much greater emphasis has to be placed on detailed fleet statistical systems, fishing vessel records, and vessel and gear characteristics will need to be further specified and detailed. Fisheries authorities may also need to re-construct the history of the fleet over an extended period (date of construction and of major vessel/gear modifications, dates of entry into specific fisheries, etc.), because in the absence of such information, it will be difficult and costly to examine long-term fleet dynamics – a requirement for the design of capacity management schemes in general and for input control in particular.

The IPOA-Capacity emphasizes that States should develop and maintain appropriate and compatible records of fishing vessels, further specifying conditions for access to information. The Compliance Agreement also calls for States to support the establishment by FAO of an international record of vessels operating on the high seas. Thus, there is a growing call for comparable records and information to facilitate fisheries and, in particular, capacity management.

## 4. ASSESSING, MEASURING AND MONITORING CAPACITY

In order to manage fishing capacity, States must first determine how much capacity exists, and how much is required to achieve the objectives of management. The IPOA-Capacity outlines a number of requirements for Member States to measure, assess, and monitor fishing capacity at the national, regional and global levels. (See, for example, paragraphs 11, 14, 15 and 20).

The method used to measure and assess fishing capacity will depend on the type of fishery being considered and the level and type of data available or readily collected. In this section, examples of techniques for monitoring, measuring and assessing capacity will be given with reference to a simple fishery. Additional considerations for more complicated fisheries will also be discussed.

### 4.1 Defining a fishery

Ideally, fishing capacity needs to be measured, monitored, and assessed when managing capacity at the level of a fishery and its fleet(s). However, defining fisheries and fishing fleets (or, similarly, grouping the types of boats that are going out to fish) are not straightforward undertakings.

The simplest fishery consists of a single fleet using a single gear targeting a single species in a given geographical area (Figure 4a). However, a simple fishery may also contain a number of fleet segments (groups of boats) using different gears targeting a number of different species in the same geographical area (Figure 4b). Even with such differences, one can consider that the fisheries are essentially "simple" ones as they are relatively self-contained, with interactions limited to vessels (boats) within the fishery's boundary.

In the case of the simple fishery presented in Figure 4b, it may be possible that a separate fishery can be identified that uses a particular gear to target a particular species that is not caught by the other vessels, even though all vessels operate in the same geographical area. For example, in Figure 4b, fleet 3 may only catch one of the species, while fleets 1 and 2 catch both the other species in differing combinations. Hence, the concept of the fishery is defined by the level of interaction within a geographical location.

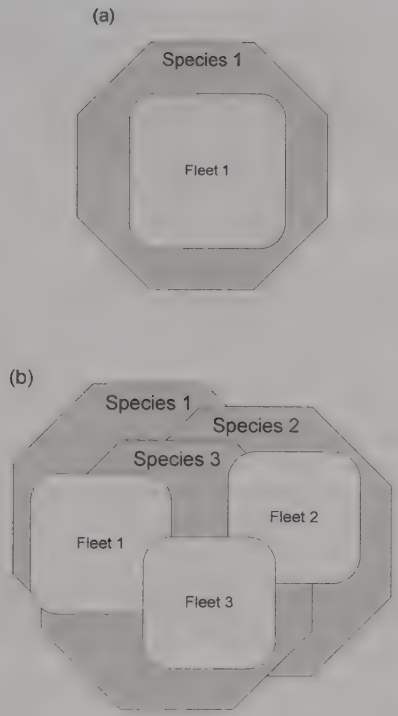


**Figure 2. Simple fisheries with (a) single fleet and species; (b) multiple fleets and species**

Trying to define fisheries becomes more complex when different fleets target different species in overlapping but different areas. For example, inshore artisanal boats may target some species that extend into deeper waters, where they are taken by an offshore fleet using different gears (e.g. Figure 5). In addition to the common species, both the inshore and offshore sectors may also catch a number of species not caught by the other boats, and the extent of their interactions may vary. Further, the different groups of boats may be subject to different management restrictions.

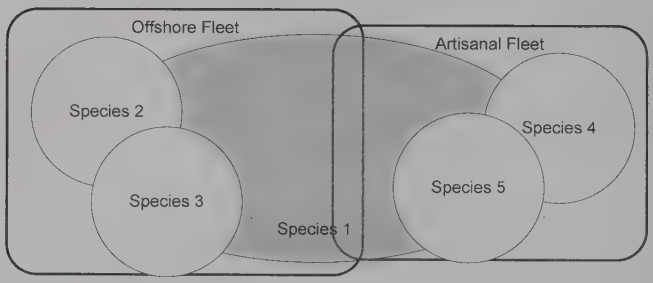


**Figure 3. Spatial structure of more complicated multispecies, multifleet fishery**

A further complication in trying to define a fishery may arise when the stocks extend across international boundaries (i.e. shared stocks) and the fleets belong to different countries (Figure 6). This may result in different fleets fishing on different sets of species that overlap to different degrees. In such circumstances, the ability of one country to manage or otherwise regulate the activities of the fishers of the other country is depends completely on collaboration.

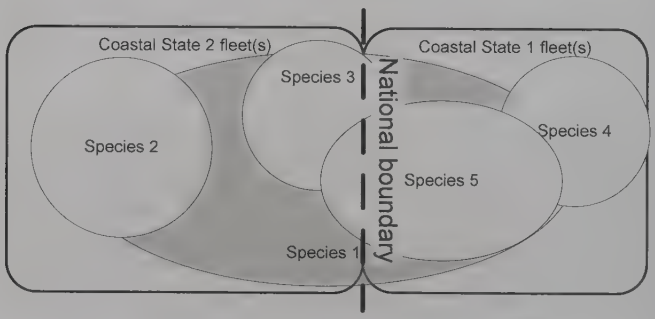


**Figure 4. Transboundary fisheries**

The example illustrated in Figure 6 is analogous to the situation where the stocks extend into international waters (rather than into adjacent national waters). In such cases, and although individual States can work to manage and regulate their own vessels, regulating the collective activities of all of the vessels in the international waters is only possible through collaboration by all participating States, such as through regional fisheries management organizations (RFMOs).

## 4.2 Simple fishery case

The simple fishery illustrated in Figure 4 will be used for the purpose of developing the concepts and methods for measuring, assessing, and monitoring fishing capacity. Additional considerations relating to more complex situations will be provided in the next section.

### *4.2.1 Determining target capacity*

The objective of capacity management is to align the productive capacity of the resource with the harvesting ability of the fleet to ensure sustainability. This requires not only assessing how much fishing capacity currently exists, but also how much fishing capacity there should be in the fishery to achieve this objective.

Target capacity was previously defined as the desired level of capacity, but this depends on the objectives of the management plan for the fishery. Three potential target capacity levels include levels that:

- maximize total fishery profits (the effort at the maximum economic yield, $E_{MEY}$),
- maximize total fishery output (the effort at the maximum sustainable yield, $E_{MSY}$), or
- maximize employment in the fishery on a sustainable level (equivalent to the level of effort at the open access equilibrium, $E_{OA}$).

These are illustrated for the case of a simple single species, single fleet fishery in Figure 7, which illustrates the sustainable revenue function and the total cost associated with each effort level.

From Figure 7, setting a target capacity below $E_{MEY}$ provides no benefits as greater output, profits and employment could be achieved at higher levels. Similarly, setting a target capacity above the open access level of effort, EOA, is economically unsustainable as costs exceed revenues. The target capacity should therefore fall somewhere between $E_{MEY}$ and $E_{OA}$ in terms of inputs, and between MSY and MEY or the open access yield, OAY, in

terms of outputs. The exact point will depend on the relative importance of output, employment and profitability in the objectives of the management plan.

A number of methods are available for determining the target capacity. These include both qualitative to quantitative methods, the choice of which will depend on the level of information available. A number of indicators are also available that provide information of where the fishery is in relation to potential target capacity levels. These are described further in the section on measuring capacity.

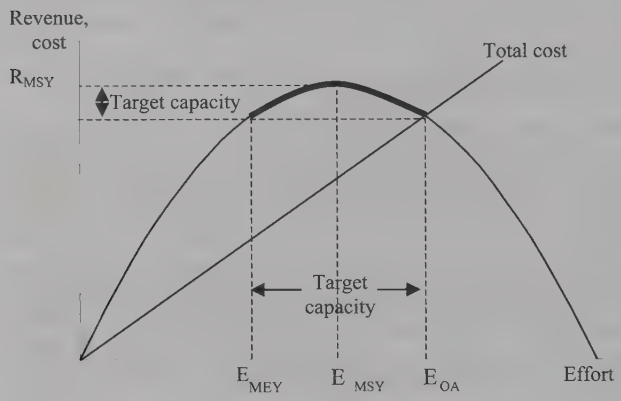


**Figure 7. Potential target capacity limits**

In the absence of detailed information on the fishery, expert opinion (based on the knowledge of scientists and stakeholders) might be used as a means of determining target capacity levels. Rapid appraisal techniques and such expert knowledge have been used to derive estimates of a wide range of measures when data are not available, and these are based on the subjective assessment of individuals who are in a position to provide an informed judgement. This might involve fisheries scientists who have been associated with the fishery for several years or their industry member counterparts who are able to provide information on how the fishery has changed over time. For example, fishers may be able to provide a picture of how the fishery

looked, say, 10 years ago, and how it has changed since then. They may also be able to provide an indication of current capacity utilization by comparing their current activity levels to previous levels.

As with any subjective judgement, the information is subject to bias. However, collecting information from a variety of individuals, or the use of semi-formal techniques (e.g. the Delphi technique) may result in consistent trends in the information being detected. In the absence of any other information, the use of subjective expert judgement should not be discounted, although the results should be used with caution.[6]

A more formalized approach to setting target fishing capacity is to use bioeconomic modeling techniques to identify the potential target output and input levels. Bioeconomic models incorporate both biological models and economic information, thereby enabling estimates not only of $E_{MEY}$ and $E_{OA}$, but also $E_{MSY}$. Multi-objective bioeconomic models enable a wider range of considerations to be incorporated when determining target capacity.[7]

Whether using qualitative (subjective) or quantitative (objective) methods for determining target capacity, States should remain cognizant of the precautionary principle relating to the management of fisheries and the marine environment. Given the uncertainty inherent in fisheries analyses, States should generally aim at a lower level of target capacity (e.g. $E_{MEY}$), and avoid targets that may result in high effort levels and lower yields (such as $E_{OA}$).

### *4.2.2 Monitoring*

In addition to determining target capacity and measuring existing fishing capacity, States need to know how fishing capacity is changing in a fishery as a result of a fishing capacity management plan, i.e., States need to monitor fishing capacity. States also need to be aware of changes in the status of the stocks and economic performance of the sectors, as these will also influence how the capacity management plan is implemented. Knowledge of the status of capture fisheries and associated resources, including socio-economic aspects, is fundamental to sound policy making and responsible fisheries management.

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[6] Further details on the use of quantitative assessments, expert opinion and stakeholder knowledge are provided in FAO Fisheries Technical Papers No. 433/1 and No. 433/2.

[7] Details on the use of multi-objective modelling is provided in FAO Fisheries Technical Paper No. 433/2, and an example of the use of multi-objective bioeconomic models for determining target capacity in a multispecies, multifleet context is given in FAO/ADRIAMED Technical Document No. 13.

The *Technical Consultation on the Measurement of Fishing Capacity* (FAO Fisheries Report 615) identified four levels of information necessary for monitoring – i.e. for ongoing measurement and assessment of fishing capacity (Table 1). The level of information will determine the methods that could be used to measure and assess capacity, with the lower levels enabling only simple methods to be employed, and the higher levels enabling more complex methods.

Level 1 is the minimum data required for assessing the current status of the fishery in terms of capacity, and may be obtained through either formalized monitoring of the fishery, rapid rural appraisal or through expert opinion. Indeed, Level 1 information is sufficient for assessing capacity in the simple fishery case illustrated above. A fishery will be overcapacity if the effort level, which may be represented by the number of vessels, is greater than the target number of vessels. The IPOA-Capacity also suggested that, at a minimum, States should develop and maintain appropriate and compatible national records of fishing vessels in line with the standards being developed by FAO (paragraphs 16 and 17).[8]

The Technical Working Group also suggested that States should aim to develop monitoring systems that will eventually result in Level 4 information, although it recognized that this is not immediately possible in many countries. Such higher levels of information, however, will be needed for measuring and assessing capacity in more complicated fisheries.

### *4.2.3 Measurement of existing capacity*

In the case of the simple fishery with a single fleet harvesting a single species, simple indicators such as total vessel numbers provide a reasonable measure of the level of capacity. This can be further refined through consideration of total fishing effort (e.g. total days fished), or including a measure that captures some of the heterogeneity in vessel size (e.g. total engine power or total gross tonnage). These are input based measures of capacity and represent an approximation to the harvesting ability of the fleet. The greater the detail in the measurement, the more accurate the

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[8] States should also be aware of the FAO *Strategy for Improving Information on Status and Trends of Capture Fisheries* (FAO, 2003) when designing monitoring and data collections systems. The overall objective of the Strategy is to provide a framework for the improvement of knowledge and understanding of trends and status of fisheries that can be used for improved fisheries management (including capacity management) and policy. The Strategy encourages States to enhance their capacities to collect data to ensure coverage of fisheries information is complete as possible.

**Table 1. Information necessary for monitoring and assessing capacity**

| Level | Information |
|---|---|
| 1 | An estimate of total landings; in vessel-based fisheries, an estimate of total vessels; in non-vessel-based fisheries, number of participants or a measure of the total gear units in use (e.g. total number of beach nets). |
| 2 | As for Level 1, plus an index of vessel size and/or power; gear type; a "rough" index of trends in fishing success; "rough" measures of total time spent fishing and maximum time that could be spent fishing under normal operating procedures per year or season; basic relevant characteristics of fishing operations (e.g. seasonality, number and types of other fisheries in which vessels operate, use of fish aggregating and fish finding devices such as fish aggregating devices or FADs, sonar, satellite tracking, other examples of changes in technology, autonomy of vessels, trans-shipment practices). |
| 3 | As for Level 2, plus total catch (including discards) split by fleet segment and by species; basic biological information (e.g. resource distribution, catch by species, size structure, "rough" estimates of potential maximum sustainable yield); comprehensive primary characteristics determining fishing power (e.g. gross tonnage or other volume measures, engine power, fish hold capacity, vessel age); comprehensive information on gear type and dimensions; prices or revenues by major species; detailed effort and catch per unit of effort (CPUE) data, including time spent fishing. |
| 4 | As for Level 3, plus detailed biological information on fish stocks (e.g. estimated biomass, fishing mortality rates, age/size structure, uncertainty in stock assessments); comprehensive data on other important features of the fishery such as detailed information on fish aggregating and finding devices (e.g. sonar, FADs, satellite tracking), skipper and crew skill levels, fuel consumption, autonomy of vessels, processing capacity, cost and earnings information, value of capital stock, employment, subsidies and economic incentives, and fishing operations relative to fish distributions. |

representation of harvesting capabilities. For example, two similar sized fleets in two different fisheries may have the same number of vessels, but one consisting of much larger vessels than the other. In this case, gross tonnage may be a better estimate of capacity than vessel numbers alone.

An alternative to using input based measures of capacity is to use output measures. These are more explicit estimates of the potential catch of a fleet and allow for the fact that some of the inputs in the fishery may not be fully utilized. Several methods have been developed to determine the potential catch, including peak-to-peak analysis, stochastic production frontiers (SPF) and data envelopment analysis (DEA).[9]

Peak-to-peak analysis is relative simple method that compares catch rates in different time periods, and estimates potential catch based on peak catch rates either side of the year examined. The minimum information requirement is a time series of total output (i.e. total catch) and total inputs (e.g. days fished or vessels numbers). Although it is simple to calculate, it does not allow for changes in stock conditions.

Both DEA and SPF are frontier based methods. That is, they are based on estimating the production possibility frontier – the maximum level of output that might be expected given a set of inputs. These can be used for the estimation of both capacity utilization and technical efficiency (see Appendix IV for further details on these measures). The techniques require catch and input information on individual vessels, and they can be used to estimate the potential catch of each vessel separately. This requires more detailed information than that required by the peak-to-peak analysis, but provides a more reliable estimate. The DEA and SPF estimates of capacity are estimated using different procedures. DEA is a (non-parametric) linear programming based approach, whereas SPF is a (parametric) statistical based approach. SPF allows for some of the differences in output between similar boats to be explained by random error, whereas DEA assumes all differences between similar vessels to be due to a combination of inefficiency and underutilized capacity.

The critical implication of these different ways of measuring existing capacity is that they generate different estimates that are not directly comparable. Thus, if policy-makers are trying to make decisions on the basis of capacity measurements, the estimates have to be done using the same technique.

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[9] Details on the three output-based approaches, including a comparison of their use, are given in FAO Fisheries Technical Paper No. 433/2.

### *4.2.4 Assessing overcapacity: the role of indicators*

Given that managers are able to define target capacity in terms of inputs and/or outputs, a fishery can be considered to be imbalanced if the current capacity is different to the target capacity. This is easier to assess in terms of input based measures than output based measures. For example, if the current fleet size is greater than the target fleet size, then the fishery has overcapacity. However, if target output is, for example, maximum sustainable yield (MSY), then the output may be either above or below the target value if the fleet is too big.

This is illustrated in Figure 8, where $C_{MSY}$ and $E_{MSY}$ are the assumed output and input target capacity measures respectively, and the fishery currently has $E_1$ units of effort (inputs). In terms of inputs, $E_1$ is greater than $E_{MSY}$, so the fishery is clearly subject to overcapacity. The catch in any one year at $E_1$, however, will depend on the state of the stocks. If the stocks are relatively healthy (either through the fishery not yet being fished down to the sustainable level, or even due to one or two years of better than average recruitment), then the capacity output may be $C_1$, based on the short term catch curve 1. This is greater than $C_{MSY}$, so the fishery clearly has overcapacity. However, if the stocks have been fished down to their equilibrium level, then the capacity output may be $C_2$. This is below $C_{MSY}$. Hence, it is not appropriate to assess the level of overcapacity in the fishery using output based measures alone.

Qualitative assessments of overcapacity in a fishery can also be based on a number of indicators, and these may be particularly important when the long run potential of a fishery is unknown and appropriate target capacity measures are difficult to estimate. Qualitative assessments should use verifiable indicators that are based on scientific methods so as to apply common yardsticks to all fisheries and minimize the role of subjective judgment. At the same time, it is recognized that the judgement, individual knowledge, and experience of the analysts will necessarily play an important role. The indicators approach has important advantages: it makes maximum use of existing information and it incorporates biological, management, and fleet-specific data.

Qualitative capacity indicators can be developed from bioeconomic theory based on existing conditions in or characteristics of a fishery. Clearly, no single indicator is sufficient to make a determination of overcapacity in a fishery; instead a combination of indicators utilizing time trend information is needed to determine qualitative capacity levels in fisheries. Nonetheless,

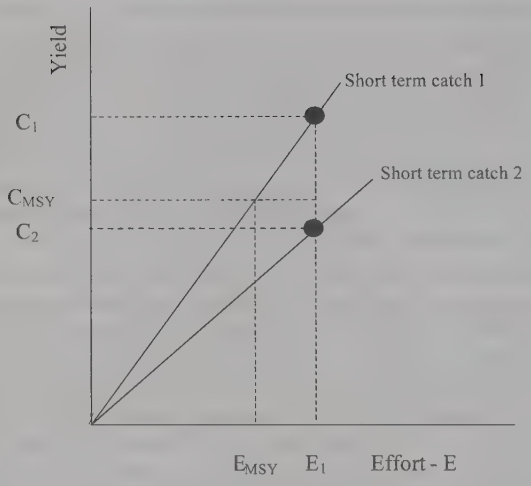


**Figure 8. Short term catch and capacity output**

in the absence of funds for undertaking research and in the interest of acting more rapidly to recognize and address capacity problems, it may be useful to use a combination of indicators of overcapacity including:[10]

- the biological status of the fishery;
- the catch per unit effort (either in quantities or in value);
- reduced compliance and increased conflicts;
- the TAC and the season length;
- the existence of latent permits; and/or
- declining profitability in the industry.

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[10] This section summarizes FAO Fisheries Technical Paper No. 433/1 *Measuring and assessing capacity in fisheries. 1. Basic concepts and management options* (Ward *et al.*, 2004). States are advised to consult this document for further details. Further indicators relevant to fisheries management can be found in FAO, 2000b. *Indicators for sustainable development of marine capture fisheries*. FAO Technical Guidelines for Responsible Fisheries, No. 8.

Such qualitative indicators may suggest the existence of overcapacity at a point in time, but do not necessarily indicate the magnitude of the problem or the direction of change. Additionally, time series of these indicators are preferable for determining the direction of changes in capacity. Nevertheless, such indicators may prove useful when more quantitative approaches are unavailable or limited due to lack of data.

4.2.4.1 Biological status of the species stock

In the simple single species fishery, if the species is overfished, overcapacity almost certainly exists since overfishing and overcapacity are both symptoms of the same underlying management problem, and this can be verified using expert opinion and other subjective-based methods if individual species fisheries are believed to be overfished, fully exploited or underexploited.

This indicator may apply somewhat differently to multispecies fisheries. Multispecies fisheries may include a mix of overfished, fully utilized and underexploited species. As will be discussed later, an overfished species in such a case does not necessarily indicate overcapacity. In these cases, the individual analyst in each region has to determine capacity levels on a case-by-case basis.

4.2.4.2 Catch and value per unit of effort

A decline over time in catch per unit of effort (CPUE) implies a decline in the stock size and, consequently, overfishing and overcapacity. However, the CPUE indicator of overcapacity must be used with care. Fluctuating total allowable catches (TACs) under a constant-fishing-mortality management strategy could mask this effect. In such scenarios, the CPUE could remain constant or improve even with overcapacity in the fishery as the TAC increases with the recovery of the stock. In addition, CPUE trends could remain constant or increase for schooling species even though overall stock abundance is declining, particularly if advances in technology to find and catch fish are compensating for declines in a stock.

Where information on prices is available, it may be possible to estimate average value per unit effort (VPUE). This is a particularly useful measure for multispecies and/or mixed fisheries. Value per unit effort may decline even though catch per unit effort remains relatively constant if fishers switch their effort onto lower valued species as the higher valued species become depleted (i.e. fishing down the value chain). Similarly, lower value per unit of effort may also occur if there is increased retention of lower valued (and previously discarded) species as a result of lower catches of higher value species. Where prices vary with the size of the species,

declines in value per unit effort may also indicate an increased proportion of small fish in the catch.

In all of these cases, declines in the value per unit effort are indicative of overexploitation, i.e. overfishing, of the key species and of the existence of overcapacity. Indeed, in general, in fisheries where TACs and harvest levels are fairly constant, a declining trend in CPUE or VPUE over time probably indicates overcapacity.

#### 4.2.4.3 Compliance and conflicts

An imbalance between the harvesting capacity of a fleet and the output level desired by the fishery's managers will manifest itself as non-compliance with regulations and conflicts between fishers and managers.

For example, in fisheries managed through output controls, overcapacity likely exists if the harvest level exceeds the total allowable catch (TAC) on a regular basis, assuming that the target, or optimal, level of capacity is the level that is necessary to harvest the TAC in a single species fishery during a fishing season.

It should be noted that this – like all qualitative indicators - is not a perfect indicator of overcapacity. If effective enforcement and monitoring of catches closes the fishery before the TAC is exceeded, overquota catches may not be observed. In addition, this indicator may not work well in multi-species fisheries unless nearly all of the species (or, at least the high valued ones) are being overharvested. Nevertheless, under most circumstances, a harvest-to-TAC ratio that exceeds "one" on a regular basis indicates that overcapacity likely exists.

Controversies surrounding the setting of the TAC and the extent to which conflicts arise when setting its sub-allocation or distribution among different user groups may also be indicative of overcapacity in a fishery. These conflicts occur when each group could potentially catch, and would like to catch, more than they are allowed. Typically, disputes occur between commercial fishermen using different gear types or residing in different areas, and/or between commercial and recreational fishermen. Evidence that the determination and sub-allocation of TACs are accompanied by a meaningful level of political controversy suggests that there may be a potential for the existence of overcapacity in that fishery. Obviously, this is a rough indicator of overcapacity for the simple reason that it is difficult to evaluate the motivations for and the seriousness and intensity of such conflicts.

#### 4.2.4.4 The TAC and season length relationship

Another indicator of overcapacity is the "race for fish" in which fishermen harvest the TAC before the anticipated or scheduled end of fishing season. If the number of days the fishery is open before the TAC is reached declines progressively for a number of years, this may be an indicator of overcapacity.

This is not a perfect indicator of overcapacity as it depends not only on the level of fishing activity but also the relationship between the TAC and stock levels. Seriously depleted stocks may require in more time being need to take the entire TAC if the TAC is not reduced in line with stock conditions. Indeed, in such cases the season length could even increase despite the overcapacity. Conversely, reductions in the TAC to achieve stock rebuilding will result in a shorter season, even if the fleet is the "right" size to harvest a fully recovered stock.

Using the ratio of TAC to season length reduces some of these problems – at least in terms of the impacts of TAC reductions. An increase in this ratio (i.e. either the TAC increases with no additional days needed to harvest it, or the TAC decreases or remains the same but the number of days the fishery is open decreases by a greater proportion) suggests that total fishing capacity is increasing.

Again, this is still a qualitative and subjective indicator as declining stocks could result in the season length remaining the same or increasing even if TACs were reduced. Nevertheless, an increase over time of this ratio could indicate the potential for overcapacity in a fishery.

#### 4.2.4.5 Latent permits

Another qualitative indicator of overcapacity is the trend in unused permits, or latent permits. In fisheries that have some form of licensing scheme and that limit the number of participants, if there are latent permits (licenses issued to fishers that have never been, or are not currently being, used to harvest fish), the ratio of active permits to total permits (active plus latent) may be used as an indicator of overcapacity.

A relatively large number of latent permits, or a low ratio of active to total permits, would indicate the potential for overcapacity in a fishery. Further, as this ratio declines, the likelihood that overcapacity exists in the fishery probably increases.

This, again, is not a perfect measure of overcapacity since speculators who never intend to harvest fish may hold a permit in the hope of benefiting by selling or leasing the permit if they are made transferable. In addition,

fishery managers may decide to purchase or cancel inactive permits. Nevertheless, a relatively low and declining ratio of active to total permits may under certain conditions indicate overcapacity in a fishery.

4.2.4.6 Declining average profitability

Fisheries are capable of producing considerable levels of economic profits, but these profits will decline as a fishery becomes increasingly overcapitalized, the fish stock(s) deteriorate, and overfishing occurs. Hence, a decline in the average profitability of the fleet is most likely associated with overcapacity.

A change in average profitability of a fleet is an imperfect indicator of change in overcapacity as it is also affected by changes in prices and costs. These in turn may be influenced by factors outside of the fishery – for example, exchange rate changes, fuel cost changes, and price changes due to changes in the supply of farmed fish. These factors may either increase or decrease profitability independent of the state of the stocks. Hence, further analysis of the data is required to determine the cause of any change in profitability. Nevertheless, low levels of the average profitability of the fleet are most likely an indication of overcapacity, although low profitability may also indicate that there are no alternatives for fisheries in a fishery and the opportunity costs are zero (or at least very low, as may be the case for artisanal fishers).

## 4.3 More complicated fisheries

The basic framework for the monitoring, measurement and assessment of capacity described above is most readily applicable in the case of the single species, single fleet fishery. However, as indicated earlier, many fisheries are considerably more complex, involving either many fleets, many species and, in some cases, many countries. Such fisheries require additional considerations when estimating their level of capacity.

### *4.3.1 Multifleet, multispecies fisheries*

The identification of target capacity and the measurement of capacity become increasingly complex the more species and fleets that operate in a fishery. Vessels using different gear types will catch different combinations of the set of species in the fishery. Hence, the input-based target capacity requires not only an estimate of total vessel numbers, but also vessel numbers by gear type. Identifying an output-based target capacity is equally complex. For example, with several species, it is not possible to achieve MSY or MEY for all species simultaneously, and an optimal mix of harvested species may result in some species being overexploited and others

being underexploited. Which species and the degree to which they should be under or overexploited will vary from case to case and may be difficult to ascertain with subjective methods.

The use of simple indicators to assess overcapacity also becomes more difficult in complex fisheries. For example, given that an optimal set of stocks may result in some species being overexploited, the use of estimates of the stock status as an indicator of overcapacity is unreliable unless that stock is the priority stock to be harvested. However, information on trends may still be useful. For example, a general decline in CPUE and/or VPUE over time for all or most species would still suggest the existence of overcapacity, as would deterioration in the status of most of the stocks. Similarly, shortened fishing seasons and increased conflict in the fishery would also indicate problems of overcapacity.

While more complex, the quantitative methods for assessing and measuring capacity described above can be applied although they, too, become more complex and require considerably more information. Bioeconomic models can incorporate multiple fleets and multiple species and can be used to estimate optimal fleet sizes and catches given the objectives of the fisheries management plan. in turn, these optimal fleet sizes and catches can be used to define target capacity (in input or output terms, respectively).[11]

In terms of measuring existing capacity in more complicated fisheries, the DEA technique offers the greatest potential because it can readily incorporate multiple species and, as it is based at the vessel level, capacity output can be aggregated across the fleet – even across different gear types. More recently, fleet adjustment models have been linked to DEA analyses to provide an indication of how many boats would have been required to take the catch of the different species.[12] These models provide an estimate of the potential short run level of redundant capacity (i.e. the excess number of vessels in the fishery which is an indicator of overcapacity) and provide a link between output and input indicators of overcapacity. However, additional consideration is required before the analyses can indicate how many vessels may have to be removed to meet the management objectives, as the redundant capacity may be a result of deliberately low quotas (e.g. as part of a stock recovery programme) or a poor season.

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[11] As noted previously, an example of the application of such a multi-objective bioeconomic models for determining target capacity in a multispecies, multifleet context is given in FAO Fisheries Circular No. 994.

[12] A recent example is provided by Tingley and Pascoe (2005) and Lindebo (2005).

The added complexity of multispecies and multifleet fisheries does not preclude the use of expert opinion of qualitative approaches. In many cases, these can supplement the more objective quantitative analyses as not all factors can be incorporated into such analyses. Further, simple analyses can still provide a good indication of the extent of any effort reduction required.[13]

*4.3.2 International fisheries, high seas and straddling stocks*

A major complication when monitoring, measuring and assessing capacity when fisheries and stocks extend beyond the boundaries of a coastal state is access to information. Similarly, any definition of target capacity needs to take into consideration the activities of those fishers who may be outside the sphere of influence of one country's fisheries management agency. For fisheries that straddle adjacent EEZs, different management objectives may result in different, and potentially non-compatible, target capacities. For example, one State may wish to set MEY and $E_{MEY}$ as targets for capacity management, whereas the adjacent State may wish to set OAY and $E_{OAY}$. For high seas fisheries, individual States may be unable to set targets for their own fleets even though free and open access in high seas fisheries has been the major cause of overcapacity, particularly with tuna fisheries.

Regional fisheries management organizations (RFMOs) can play a major role in coordinating measuring, assessing, and monitoring capacity as part of their overall management role for a region as a whole. Furthermore, ratification of the Agreement to Promote Compliance with International Conservation and Management Measures by Fishing Vessels on the High Seas by all contracting States will increase the ability of RFMOs to take a larger role in setting capacity targets and in measure, assessing, and monitoring fishing capacity. The potential role of RFMOs is discussed in Section 5.5 of these Guidelines.

*4.3.3 Artisanal fisheries*

The term "artisanal" is often used to describe a range of small scale fishing activities. These include small-scale fishers who may be fishing either part-time or full-time to make money or to have fish for trade. The key characteristic of an artisanal fleet is that the fishers use small vessels, mostly operate close inshore, and catch relatively small quantities of fish on an individual basis. The vessels are often polyvalent, catching a range of

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[13] It is possible to demonstrate that a reasonable estimate of the degree of excess effort can be derived by considering only the dominant species in a fishery (in terms of value) and aggregating the effort of different fleets into a single composite effort measure (Chae and Pascoe, 2005).

species and using of a number of different types of fishing gear. The capital used by these fishers may not involve a vessel but, instead, may take the form of fishing gear or even labour. In such cases, the most appropriate inputs should be used to define fishing units in subsequent analyses.

Fishers in this group, rather than operating according to a strict, firm level objective, may also be more concerned about satisfying or maximizing utility subject to various constraints. Similar problems are likely to exist when attempting to assess capacity in recreational fisheries.

In many countries small-scale fishing is also associated with part-time farming (or other activities). Hence, when conditions are not favourable for farming, fishing activity may increase, and vice versa. In such cases, the potential capacity of this group should be considered in the same manner as full-time fishing units. This will result in these fleet segments demonstrating substantial latent effort and capacity underutilization. These need to be considered when assessing the overall level of overcapacity in the fishery.

Small-scale commercial fishing units operating on a full-time basis need to be assessed in the same manner as their larger counterparts in the measurement of fishing capacity. However, data related to this sector are often poor or non-existent. As a result, the available approaches may be limited and resulting estimates, subject to some uncertainty. This may present problems when aggregating capacity measures at the national or regional level, particularly if output-based measures of capacity by species are not available.

### *4.3.4 Recreational fisheries*

Recreational fisheries can have a substantial impact on some species. However, in most recreational fisheries, catch and activity levels are largely unmonitored. States need to consider the assessing recreational fishing capacity, including the routine monitoring and collection of information on recreational fisheries, particularly where they are believed to have an impact on the stocks.

The concept of recreational fishing capacity involves determining the existing level of activity and catch could be considered the capacity level, as this is what is supplied under normal (unregulated) conditions. While most recreational fisheries are essentially open access, effort does not respond in the same manner as for commercial fishers (where effect increases until all economic rent has been removed from the fishery). Both entry and exit are often relatively unconstrained as the cost of entering/exiting is frequently low. Further, the benefits of recreational fishing may not depend fully on the quantity of catch, as it is often considered an "experience" activity. However, the open access nature of the fishery as well as the low

participation costs may still result in stocks becoming overexploited even if capacity subsequently declines.

Determining target catch levels for recreational fisheries and/or limiting fishing activity may be appropriate if there is considerable interaction between recreational and commercial activity (i.e. if the fisheries target the same species), or, in the case of non-commercial species, if the stocks are overexploited as a result of the level of recreational activity. In such cases, recreational fisheries will need to be managed and monitored.

*4.3.5 Highly variable species*

Many pelagic fisheries are subject to large inter-annual variations in catch, because stock size is highly dependent upon spawning success and subsequent recruitment, both of which are highly susceptible to variations in environmental conditions (e.g. food availability and water temperature). Similarly, many shrimp fisheries are subject to large stock fluctuations as a result of fluctuations in environmental conditions. These represent extreme examples of the general issue of short run fluctuations in stocks that generate output changes that should not be attributed to capacity changes.

The issue of short-run fluctuations is particularly a problem when imputing long-run measures from short run evidence; for example, when comparing current capacity output measures with target catch estimates such as MSY. As noted above, target measures are based on long run equilibrium values of output based on a stable (or average) stock size, whereas current capacity output estimates are based on current stock size. If comparison is carried out using these types of measures, it is particularly likely that a fishery may be perceived as not having overcapacity in a "poor" recruitment year, because capacity output is less than (average) target capacity. However, the level of inputs employed may be greater than that which would be expected to produce the target capacity under "normal" or average conditions. Conversely, a fishery may be perceived as having substantial overcapacity in a "good" year when capacity output exceeds target capacity, but the level of inputs may be less than or equal to the level associated with target capacity under average conditions.

In such highly fluctuating fisheries, controlling for stock levels and for long-run comparisons that impute capacity output levels at target rather than current biomass stock levels is critical for constructing interpretable and useful measures. For short run comparisons, if a bioeconomic model of the fishery is available, optimal yields given current stock conditions can be estimated to provide a short run measure of target capacity for comparative purposes. Also, directly constructing input-oriented measures of capacity

could bypass some of these issues if an estimate of optimal input use at (average) target capacity output can be derived.

## 5. MANAGING FISHING CAPACITY: MANAGEMENT MEASURES AND THEIR EFFECTS

The management of fishing capacity can be defined as the implementation of a range of policies and technical measures aimed at ensuring a desired balance between fishing inputs and production from capture fisheries.

Overcapacity in a fishery arises as fishers respond rationally to the economic incentives that they perceive. Without effective management, fishing capacity can be expected to increase either through new entry to the fishery or through increased investment by existing fishers as long as significant profits exist.

Because overcapacity arises from inadequately defined rights of access, the development of a policy framework for the management of fishing capacity requires that fisheries authorities simultaneously develop policies to limit and/or put a price on access. Simply limiting entry will not be sufficient to prevent capacity expansion because it will remain difficult to control the increased capacity generated by the existing fishers. To be successful, measures to manage capacity must take both sources into consideration

The IPOA-Capacity requests States to develop, implement and monitor national plans of action for managing fishing capacity, taking into account, *inter alia*, the effect of different resource management systems on fishing capacity (Article 19). In developing a policy to deal with overcapacity, States may opt for one of two broad approaches (Gréboval and Munro, 1999). The first approach is system through which the State attempts directly to manage capacity levels. The second approach is to establish a system that provides economic incentives for fishers to control fishing capacity of their own accord, eliminating the need for direct State intervention. These systems and their relative efficacies and costs - are described in the following sections.

### 5.1 Capacity management, effort management and fisheries management

The distinction between capacity management and effort management is subtle in terms of short term impact on the stock but has longer term implications for both the stock and the economic performance of the fleet and the fishery. Both can be included within the general framework of fisheries management (Figure 9).

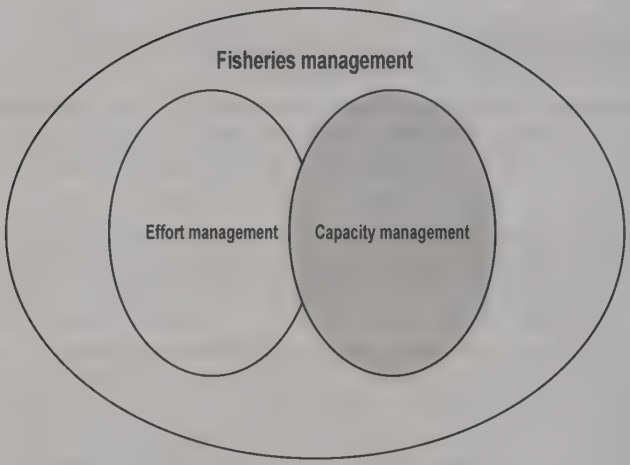


**Figure 5. Relationship between capacity, effort and fisheries management**

Reducing a fleet (as part of managing overcapacity) or reducing the number of days fished per vessel (effort management) may have the same short term impact on fishing mortality. However, in the latter case, the underlying pressures to overfish remain because the fleet still has the capability to harvest the resource in excess the desired level of exploitation. Furthermore, because the cost per unit catch will still increase with effort controls, they will reduce the profitability of the fleet.

The biological, social, and political consequences of overcapacity are primarily a consequence of open access or regulated open access if the management of a fishery does not address the property rights issue. Hence, management regulations designed to reduce or eliminate overcapacity will not have their desired result if the underlying cause is not addressed. Command and control regulations typically used to manage fisheries by entry or catch level restrictions in total or on an individual fisher basis do not address the underlying open access resource problem and will, at best, only reduce capacity in the short term.

## 5.2 Types of fisheries management measures and their relationship with fishing capacity

In most cases when dealing with overcapacity in a fishery, managers tend to focus on the size of the fishing fleet. The problem is usually stated in terms of too many fishers trying to harvest from a stock of too few fish.

The solution is usually seen in terms of trying to reduce the harvest to allow the stock to recover from its overfished state and to reduce the size of the fishing fleet to a level commensurate with long-term potential yield from the fishery

This has typically been implemented as a two-stage process. The first stage involves acting directly on the fishery using traditional command and control management techniques such as total allowable catch (TACs), trip limits, size limits, bag limits for recreational fishers, days at sea restrictions and restricted season lengths. The second stage is to impose a set of direct measures to control and then reduce the number of fishing craft that can harvest fish by limiting entry and undertaking vessel or permit buyback programmes to remove vessels from the fishery. This approach is essentially based on the notion of incentive blocking, i.e. the approach is based on administrators trying to stop the market forces that motivate fishers. However, instituting the regulations in this category to prevent or slow further increases in fishing capacity caused by open access – without changing the forces that lead to overcapacity – does not solve the fundamental problem that leads to overcapacity.

Incentive adjusting measures are an alternative to incentive blocking approaches. These measures directly change the set of incentives and forces that fishers respond to (rather than blocking them) through the introduction of some form of use or property rights into the fishery. These incentive-adjusting approaches create reasons for the fishers to correct their overcapacity by creating an operating environment in which it makes commercial sense for the fishers to do so.

The sorts of regulations that comprise these two different categories of approaches to addressing capacity are outlined below, and presented in more detail in Appendix 3.[14]

### *5.2.1 Incentive blocking measures*

Incentive blocking measures are commonly used in most fisheries management systems around the world. These measures are introduced to

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[14] This section is a summary of FAO Fisheries Technical Paper No. 433/1 (2004). States are advised to consult this document for further details.

achieve a particular short-term target (e.g. reduce fishing mortality) and are often used without consideration of the capacity-related implications of using them. Nevertheless, they have implications for capacity management. Incentive blocking measures include:

- limited entry;
- buyback programmes;
- gear and vessel restrictions;
- aggregate quotas;
- non-transferable vessel catch limits; and
- individual effort quotas (IEQs).

Incentive-blocking programmes are only effective in slowing increases in capacity in the short term. For example, a government funded vessel buyback programme could be used to reduce fishing effort level which results in a reduced harvest level in the short term until the stock can grow to its targeted level. The cost of producing the fish will decline as congestion on the fishing grounds lessens. At the same time, landings per vessel increase. The consequent higher profit levels create incentives for the individual fishers remaining to increase their effort (i.e. more fully utilize their capacity). If the initial capacity reduction was successful and stock levels increase, then the subsequent higher profits create further incentives for the remaining individuals to increase their capacity through whatever means are possible under the restrictions (e.g. input substitution, capital stuffing), thereby driving the fishery again towards overcapacity.

Restrictions on some inputs to the fishing activity create reasons for fishers to increase the use of unrestricted inputs if doing so can lead to increased individual profits, at least in the short term. This input substitution results in inefficient mix of inputs[15] being used, and can lead to further restrictions being placed on the fishery that locks the fishers into the inefficient combination of inputs (or further exacerbates the problem by encouraging the adoption of even less efficient combinations of inputs).

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[15] In this case "inefficient" is in the context of economic efficiency, as the combination of inputs is not the least cost combination, and catch is therefore being taken at a higher cost than it would otherwise be in the absence of the restriction.

### *5.2.2 Incentive adjusting measures*

A second management approach designed to reduce overcapacity in a fishery using incentive adjusting techniques is the adoption of a rights-based management regulation. These measures to control capacity change the regulatory environment and create a market incentive that causes fishers to adjust their fishing capacity. Fishery management regulations eliminate the open access externality by causing fishers to behave as if they own the *in situ* fishery resource. When fishery resources are no longer free to whoever harvests them first, fishers are willing to invest in the future by conserving the fishery resource as well as other resources used in its harvesting.[16] As a result, overcapacity is reduced, if not eliminated, in the fishery. Examples of incentive adjusting measures include:

- territorial user rights (TURFs), management and exploitation areas for benthic resources;
- community-based rights management, community fishing quotas, and other group rights in fisheries;
- designated access privilege systems (DAPS), individual transferable share quota (ITSQ) systems, individual transferable quota (ITQ) systems, and limited access privilege programmes (LAPPs); and
- taxes and resource rental charges.

Again, cooperatives, co-management, individual transferable quotas (ITQ), individual fisher quotas (IFQ), territorial user rights, and community quotas are examples of management regulations that directly internalize the market failure problem that induces overcapacity in a fishery into the production decisions of the individual firm or fisher.[17] These regulations all create a management instrument that captures the value of the resource (resource rent) and create reasons for the fishers to behave as if the resource rent is a cost when deciding how much they should produce at a given stock size – something not addressed by other management approaches. For example, a fisher will produce fish until the cost of producing the last pound of fish is just equal to the revenue it generates.[18]

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[16] See Valdimarsson and Metzner (2005) for a discussion of the use of incentive adjusting measures for successful ecosystem approach to fisheries management.

[17] Although the economic implications have not been fully discussed, an industry-funded buyback programme may also internalize the costs of an open access fishery into the fisher's production decisions.

[18] When fish in the sea are free to the fisher, they do not have to pay its value to the owner. This reduces their costs of production. The fisher overproduces fish,

*5.2.3 Relative performance of management measures*

While incentive adjusting measures are more effective in controlling capacity in fisheries, they are also generally more costly, both in terms of information needs and management (e.g. monitoring, surveillance and enforcement). However, they are also more likely to improve fisher efficiency, with consequent higher incomes and profit levels that enable fishers to better afford these higher management costs.

A selection of key management measures, listed in order of their effectiveness in containing or reducing capacity both in the short term and the long term, is presented in Table 2. This provides an indication of the potential trade-offs when choosing one policy option over another.

While some policies may have only a low effectiveness in controlling capacity, these are generally better than open access. Ideally, States should aim to adopt measures that are both effective and promote economic efficiency. This may not be feasible in the short term due to the lack of institutional capacity required to implement these policies, and the high cost of their implementation and management. However, States should plan towards implementing such systems in the future as part of establishing sustainable wealth generating fisheries.

## 5.3 Subsidies

The issue of subsidies in fisheries is more complex than in many other industries. Subsidies in fisheries may take many forms. At the fisher level, these may include direct transfers to support incomes or reduce costs or indirect transfers through preferential tax arrangements. At the fishery level, subsidies include the costs of fisheries management, surveillance and research. Subsidies may also be used at a regional or national level to encourage development in particular areas through provision of general infrastructure, or the development of sustainable livelihoods through assisting villagers to diversify their activities. There is considerable controversy whether all subsidies should therefore be considered "bad".

In most cases, subsidies – even "good" subsidies – can create incentives to increase, rather than reduce, capacity. This is because firms will invest in a fishery as long as they can derive a significant profit, independent of the overall production level. Subsidies increase profits relative to what might have existed in the absence of the subsidy, and thereby contribute to higher than expected levels of capacity.

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because the cost of the next unit of fish caught is less than the revenue it generates.

**Table 2. Summary of relative performance of different capacity management measures**

| Measure | Effectiveness in containing or reducing capacity | | Information needs | Management costs | Fisher efficiency & wealth generation |
|---|---|---|---|---|---|
| | Short term | Long term | | | |
| Limited entry* | Low | Low | Low | Low | Low |
| Aggregate (competitive) quotas | Low – Medium | Low | Low – Medium | Medium | Low |
| Gear and vessel restrictions | Medium | Low | Low | Low | Low |
| Non-transferable individual effort quotas | Medium | Low – Medium | Medium – High | Medium | Low |
| Non-transferable individual vessel catch quotas | Medium | Low – Medium | Medium – High | Medium – High | Low |
| Buyback programmes | Medium | Low – Medium | Medium | High | Medium |
| Territorial user rights | Medium | Medium | Low | Low – Medium | Medium – High |
| Transferable individual effort quotas | Medium | Medium | Medium – High | Medium – High | Medium – High |
| Community-based rights systems | Medium – High | Medium – High | Medium – High | Medium – High | Medium High |
| Individual transferable quotas | Medium – High | High | High | High | High |
| Taxes and resource rental charges | Medium – High | High | High | High | High |

*Limited entry, despite have a low effectiveness on its own, is a necessary component of all other management systems, and hence needs to be used in conjunction with all other measures.

Subsidies and other economic incentives that could lead directly or indirectly to overcapacity are numerous. In the absence of an effective capacity management policy, any incentive that provides for increased profitability could eventually lead to overcapacity in at least some fisheries. At the national level, economic incentives provided to promote global fleet development are likely to result initially in some overinvestment in the most profitable fisheries. This may be corrected to some extent by catch or entry restrictions, but as the industry matures towards the full exploitation of most available resources, economic incentives start running counter to the general objective of sustainability.

The types of subsidies and other economic incentives that could be considered to have the most direct impact on capacity are those provided for the construction, acquisition and refitting of fishing vessels, as well as those which directly contribute to significantly reducing operating costs. These incentives may take the form of budgeted grants, subsidized lending and tax and fiscal preferences. Subsidized lending and tax preferences are important, perhaps even more so than budgeted subsidies at present.

Subsidizing the capital costs of vessel construction and modernization is of great importance for fishing capacity. Subsidies on fishing capital have been used in the fishing industry for a number of reasons, such as facilitating development or supporting incomes in fishing dependent communities. Subsidized capital may take the form of either direct grants, or subsidized interest rates on loans. It is also not uncommon to find governments that have been left funding the capital costs of the industry in cases where fishers are unable to meet their capital repayments and the loan guarantees are invoked. Such situations often have detrimental side effects for fisheries management and fishing capacity, e.g. when authorities become reluctant to allow companies to become bankrupt since they hope that if the loans can be re-structured, economic viability can be restored and the government can recover its loans. As a result, capacity may be maintained at an uneconomically high level, adjustments to the structure of fishing capacity are delayed, and catch rates are kept at a lower level. This has the effect of worsening the financial situation of fishing enterprises that would be profitable (or more so) if the bankrupt part of the fleet were allowed to fold. Maintaining redundant capacity also increases exploitation rates with the usual risks for the sustainability of the resource.

In addition to subsidized capital costs, investment policies that were intended to develop fishing capacity often included tax preferences. The most widespread of these are tax-free fuel, accelerated capital depreciation, and deferred income taxes. The evidence on the cost of such tax advantages is fragmentary, but what there is suggests that the amounts are substantial.

There is also a need to consider the way in which subsidies in other sectors may impact upon fishing capacity. The most obvious example is subsidies to shipbuilding. These "unbudgeted subsidies" often appear to be carry-overs from an expansionist era. Fisheries authorities should ensure that they continue to serve the purpose for which they were implemented and that their impacts on capacity (if undesirable) do not outweigh their positive impacts on other economic variables.

Subsidies which support access to foreign fisheries should also receive attention. While they may represent a mechanism to stimulate the transfer of fishing capacity, in the absence of effective fisheries management such transfer may result in overcapacity and lead to overfishing in the recipient coastal state.

The IPOA-Capacity calls for States to reduce and progressively eliminate subsidies and economic incentives contributing directly or indirectly to the build-up of excessive capacity (Articles 25 to 26). In addition, the international fisheries community has adopted clear and defined positions and commitments in international instruments and international fora concerning the need to eliminate subsidies that contribute to overcapacity.

The main center of interest for the negotiations on fisheries subsidies is the WTO Negotiating Group on Rules based on the Doha Mandate (2001). During the WTO Ministerial Meeting held in China, Hong Kong Special Administrative Region (2005), in reviewing progress made in discussions, Ministers noted that there is broad agreement that the Group should strengthen disciplines on subsidies in the fisheries sector, including through the prohibition of certain forms of fisheries subsidies that contribute to overcapacity and overfishing.

Also the WSSD Declaration (UN, 2002) made a call to "eliminate subsidies that contribute to over-capacity, while completing the efforts undertaken at the WTO to clarify and improve its disciplines on fisheries subsidies…".

During its twenty-sixth session, the FAO Committee of Fisheries (2005) agreed that those subsidies that supported the expansion of fleets, which, when conducted in an unsustainable manner, contributed to stock degradation and fleet overcapacity should be phased out.

As part of their capacity management consideration, States should undertake a national review of the various subsidies and other economic incentives being provided to their fishing industry, together with a

qualitative assessment of their likely impact on fishing capacity, expected investment decisions and sustainability.[19]

### 5.4 Stakeholder participation

Considerable attention has been given to the benefits of stakeholder involvement in fisheries management (i.e. co-management). This has proven invaluable in the development and implementation of management plans in a wide variety of fisheries, both artisanal and industrial.

Various models of stakeholder participation can be used. The precise role that fishers and other stakeholders should play will depend on the country, its social norms, and its capacity management system. This role may range from these stakeholders having an input into the management process (e.g. through representation on advisory committees) to community or territorial use rights with devolution of management responsibility to community groups.

The benefits of widespread participation include improved compliance as well as the provision of stakeholder knowledge that can result in more effective management plans being developed. In developing policies for the management of fishing capacity, States should undertake extensive consultations with the industry and other stakeholders, and seek consensus on capacity management issues and methods. In general terms, States should consider a strong involvement of the fisheries-related stakeholders in the management of fishing capacity process as essential.

In many instances, the effective participation of stakeholders in the management of fishing capacity may require training and other activities for all the stakeholders, including fishers and fisher organizations. The introduction of new management methods may further require adjustments in the way the participants organize themselves, as well as the development of new institutional interfaces between the fisheries authorities, the fishers and other stakeholders. States should assist fishing organizations, fishing groups, fishers and others by providing the appropriate intuitional infrastructure and assisting with the development of human capital in these organizations.

### 5.5 International considerations

The management of fishing capacity in international waters and also in fisheries that are exploiting fish stocks shared by more than one jurisdiction

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[19] States should consult FAO (2004b) *Guide for identifying, assessing and reporting on subsidies in the fisheries sector*. FAO Fisheries Technical Paper No. 438.

involves an additional problem: namely, the ability of any individual State in controlling capacity is limited to managing the capacity of its fishers and does not extend to managing the overall capacity of all participants in such a fishery. As a result, without collaborative management of fishing capacity fisheries could still become overexploited even with considerable management efforts.

In the case of stocks shared by two jurisdictions, collaboration between States in both setting target capacity, monitoring and managing capacity is essential. This may take place either through bilateral arrangements (in the case of fisheries straddling adjacent jurisdictions), or through collaboration with regional fisheries management organizations (RFMOs). Consideration of capacity issues has also been raised at regional and international economic forums. For example, the Asia Pacific Economic Cooperation (APEC), the Organisation for Economic Co-operation and Development (OECD) and the Association of Southeast Asian Nations (ASEAN) have all considered issues of fishing capacity of their member states.

In principle, the technical difficulties of managing capacity in international waters are no different to those discussed throughout these Guidelines. The particular difficulties reside more in establishing a legal framework that allows for effective capacity management and in ensuring compliance with regulations given the huge areas involved and the open register issue. Because spillover effects are likely to be a particular problem, with vessels displaced from one fishery re-appearing elsewhere, if necessary by changing flag State, there is a requirement that States taking action to control their own capacity should also take into account the impact on other fisheries.

A number of regulatory frameworks have been developed that are directly aimed at addressing fishing in international waters, including the Compliance Agreement and the Fish Stock Agreement. States should comply with these existing international agreements.

*5.5.1 Collaboration with RFMOs*

Most vessels operating on the high seas are highly mobile. The great mobility of vessels, both between oceans and inside and outside of 200-mile zones, makes it very difficult to assess capacity and also highlights the need for improved coordination between the various regional fishery bodies

The UN Fish Stock Agreement requires coastal States and distant water states exploiting a straddling stock or a highly migratory stock to establish a regional fishery management organization for the purpose of managing the resource on a cooperative basis. Such cooperation is essential for the rational management of transboundary fisheries. It is now well established

in theory (and in practice) that if countries refuse to cooperate, the outcome is the same as, and may be worse than, that which occurs in fisheries exploited under conditions of free and open access. Overfishing and overcapacity are certain to emerge, and the situation may be worse because countries will be motivated to support their fleets to establish a competitive advantage. As a result, a vicious circle of competitive subsidization could easily become established, with the overcapacity that this implies.

The IPOA-Capacity identified strengthening of RFMOs and related mechanisms for improved management of fishing capacity at regional levels as a major action. Articles 27 through 38 of the IPOA are concerned with regional collaboration and participation in international agreements that relate to the management of fishing capacity. This collaboration is at two levels: first, in relation to shared or straddling stocks; and second, in relation to high seas fishing. A key role of RFMOs and bilateral agreements is the allocation of the shared resource between the contracting States by setting and allocating total allowable catches (TACs) of each species. In some cases, more explicit capacity management measures are also imposed.

For example, while the main role of Northeast Atlantic Fisheries Commission (NEAFC) is to allocate the agreed TAC between the Contracting Parties, it may also limit the number of boats and effort in line with the fishing opportunities available to that Contracting Party. Similarly, the General Fisheries Commission for the Mediterranean (GFCM) provides advice on the status of the resource, and appropriate measures for its rational management, including advice on area and seasonal closures, TACs, minimum landings sizes and fishing effort.

As part of achieving effective capacity management in international fisheries, States should collaborate with RFMOs by sharing information, participating in and developing harmonized systems of data collection and supporting the actions of the RFMO to limit capacity in the international waters. The most detailed information currently exists for the tuna fishery because the various regional tuna commissions (International Commission for the Conservation of Atlantic Tunas [ICCAT], Inter-American Tropical Tuna Commission [IATTC], Indian Ocean Tuna Commission [IOTC] and the South Pacific Commission [SPC]) collect and collate data on catches and tuna vessels. This demonstrates that collaboration is feasible for wide ranging fisheries.

### *5.5.2 Displacement of fishing capacity*

Of particular concern with the international management of fishing capacity is the displacement of fishing capacity from one area, region or fishery to

another. Vessels removed from one fishery or jurisdiction may move to another if access is not restricted.

Capacity reduction programmes such as buyouts of fishing vessels in one country may also result in a cheap source of capital for fisheries in other countries if the capital is allowed to move. If the buying country's fisheries are being effectively managed, then it makes economic sense for the country to gain access to cheap inputs. However, such transfers may still have adverse effects. In many developing countries, industrial vessels acquired in such a way have had significant impacts on local small scale and semi-industrial fleets. This problem may be especially acute where capital is being substituted for labour. Developing countries, in particular, need to pay close attention to the social costs and benefits of acquiring low cost inputs, even if their fisheries are well managed.

If recipient fisheries are near or above full exploitation, and poorly managed in the sense that they effectively remain under conditions of free and open access, then cheap inputs are unlikely to be beneficial since any lower costs of exploitation they may engender will be offset by increased levels of exploitation. Under such circumstances, capacity reduction programmes could potentially transfer the problem of overcapacity from one EEZ to another.

Fisheries authorities should assess the impacts of significant reallocations of overcapacity from their fisheries to the EEZs of other States and, if potentially detrimental, should take steps to discourage such transfers whenever possible. The IPOA-Capacity requests that States ensure that no transfer of capacity to the jurisdiction of another State occur without the express consent and formal authorization of that State.

## 6. TRANSITIONAL CONSIDERATIONS FOR CAPACITY REDUCTION

Given the condition of most fisheries, the introduction of capacity management programmes is likely to be accompanied by some degree of capacity reduction. The process for reducing overcapacity involves people and creates – at the very least – temporary uncertainty about their livelihoods and, frequently, about their incomes. Unfortunately, these concerns will probably be just as much about perceived and potential effects as about likely actual effects.

Moreover, even the unintentional failure to take account of these concerns – real or perceived – may result in poor compliance and political obstruction in the development of policies and the ultimate failure of the capacity management programme. Similarly, failure to take into consideration

alternative employment opportunities and community dependence on fishing may result in substantial social and economics costs to the local regions and may contribute to undermining the success of capacity reduction programmes.

Key transitional considerations associated with the development and implementation of capacity management include:

- allocation and distribution issues;
- social concerns and issues;
- legal issues;
- financial issues;
- political issues (including the political environment(s) in which the programme is being developed, adopted and implemented); and
- management and managerial issues, ranging from training to inspiration (Figure 10).

These concerns and issues are outlined in the following sections of the guidelines.[20] The appropriate approach to deal with these issues and, indeed, the solutions themselves, will vary from State to State and from fishery to fishery.

### 6.1 Allocation and distributional issues

A capacity management programme requires some allocation of fishing rights – either explicitly or implicitly. For example, in an ITQ programme shares of the fishery's TAC are allocated to individual fishers while for communal rights-based programmes, the shares are allocated to a predefined group or community. In both cases, those who are not allocated quotas are prevented from operating in the fishery until they, too, obtain shares, either by joining the community or purchasing shares.

The way in which fishing rights are allocated may have an unequal impact on fishers. If allocated to reflect historical reported catches or some other proxy for the extent of participation in a fishery, some newer operations may receive low levels of quota and be unviable unless they purchase additional quota, while other longer term fishers may have excess quota and hence have a windfall gain. Similarly, with buy-back programmes, some

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[20] This section summarizes the Report of the Expert Consultation on Catalysing the Transition away from Overcapacity in Marine Capture Fisheries (Metzner and Ward, 2002). States are advised to consult the full document for further details.

fishers are selected to exit the fishery with a cash payout, while any unsuccessful applicants will remain or exit without compensation. Even when simply limiting entry, some potential fishers will be excluded from a potential livelihood, making the issues of livelihoods diversification and alternative livelihoods important transitional issues.

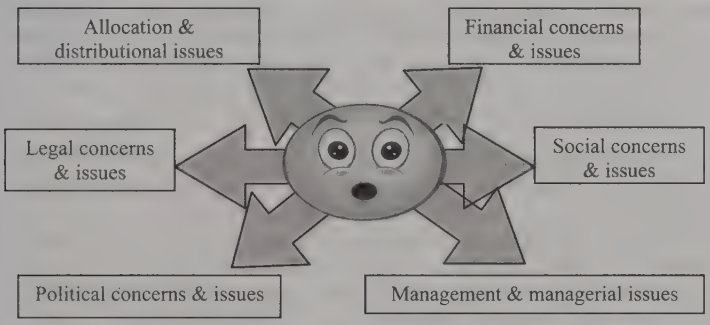
Allocation & distributional issues
Financial concerns & issues
Legal concerns & issues
Social concerns & issues
Political concerns & issues
Management & managerial issues

**Figure 10. Managing and/or reducing capacity: transitional considerations**

Allocation of property or user rights requires particular attention, because the allocation of shares has a direct and clear bearing on the revenue and profitability of each fisher. As such, of all capacity management measures its impact is most clear and obvious, hence the need for it to be accepted as a legitimate system by the industry. Acceptance (or otherwise) of the initial allocation system will affect the degree non-compliance with a new management system as a whole, and any legal challenges to the allocation system will slow down the capacity reduction as participants await any changes to the system.[21]

In most cases where ITQs have been implemented, the initial allocation has generally been based on past catch histories (e.g. catches of the species over a specified time period). Even this approach, however, has been subject to difficulties as fishers who were less active over the qualification period (having only recently entered the fishery or recently replaced their boat with

[21] Because of the direct financial implications of rights-based programmes, initial allocations inevitably have resulted in legal challenges to ITQ systems.

the expectation of higher catch levels) have received smaller shares than longer-term participants. As a result, more recent formulas for initial allocations have tried to take additional factors into account and have been based on such things as weighted averages of a variety of factors such as participation (sometimes during different time periods) and the percent of income the fisher has derived from the fishery.

An alternative to giving away shares is to auction them, thereby allowing some of the resource rent to be captured by society as a whole. Otherwise, the resource rent gets captured in the quota price, generating a windfall gain for the first generation of quota owners who may subsequently sell their quota. Subsequent quota buyers have to pay this resource rent to the initial quota holders and so do not capture the resource rent themselves.

The initial allocation will therefore determine who will be the "winners" and "losers". If capacity reduction programmes are designed solely to increase efficiency, the least efficient producers are likely to be displaced; alternatively, if other management objectives such as preserving or protecting artisanal fishermen or maximizing employment are also desired, then allocation schemes that reflect these objectives will result in shares being allocated to the other, potentially less efficient, producers.

The identification of "winners" and "losers" goes beyond just those directly involved in the fishery. Individuals who supply goods and services to or receive goods and services from fishermen will also be affected by a change in the size and location of the fishing fleet that results from capacity reduction programme.

Capacity management programmes will have other distributional effects. Individuals will have already been made worse off by managers allowing overcapacity to develop in a fishery. If the fishermen who are removed from the fishery along with their capital investment can be absorbed into another industry in the local economy, then they and the nation should be better off. That is, more goods and services will be provided to final consumers and less environmental harm will be generated by the fishing industry. This is what is described as a Pareto Optimal solution: at least one person is made better off, and no one is made worse off by the change in the management programme.

If there is no alternative employment for the fishers that pays at least as well as fishing (i.e., if the opportunity cost of fishers' labour is zero) and there is no other use for their fishing vessel (i.e., if their capital is nonmalleable), then the displaced individuals will not be able to contribute to the local economy at the same level. While this, in theory, is only a short term consideration (as unemployed laborers could eventually move to other

areas), this may undermine the perceived legitimacy of the management system and, in turn, will adversely affect compliance and the success of the system to achieve capacity reduction.

There is no simple solution to the allocation issue as every fishery will have different perspectives on user or other types of rights. Similarly, achieving one objective (sustainable fisheries) may require undesirable distributional impacts such as unemployment. Thus, the implementation process needs to:

- clearly identify the management objectives and goals;
- carefully determine the likely stakeholder groups that will be displaced or adversely affected by the capacity reduction programme; and
- take steps to identify and implement mitigation strategies to reduce these displacement effects – something that may include regional employment programmes or livelihoods diversification programmes run in conjunction with the capacity reduction programmes.

### 6.2 Social considerations

Social concerns – including concerns about future employment, displacement, cultural considerations and uncertainty created by moving to a new system - can create potentially significant barriers to designing, adopting, and implementing capacity reduction and capacity management programmes. Thus, it is critical to include and address social concerns in the design of any particular capacity reduction package.

As noted above, changes in patterns of employment are inevitable part of capacity management and adjustment programmes. The extent to which new jobs, alternative jobs or other means of earning income are readily available will influence concerns about short and long term hardship, if not poverty, for fishers and the extended community. Under other conditions, adjustment programmes may not cause changes in the total number of fishers in a fishery, but it may change the number of days and ways in which the fishers work.

In many communities fishing is considered a cultural as well as an economic activity. If there are long-standing traditions of fishing, these may be difficult to overcome. Similarly, if there is cultural resistance to not being able to fish and/or a desire to maintain fishing as a way of life, then it will be more challenging to try to convince fishers of the need to reduce overcapacity and to have fewer fishers. These are sensitive and important matters to incorporate into the design of a capacity reduction programme and to consider when working with the stakeholders to build consensus.

Unless communities can be convinced that of the value of the measures, imposing regulations under such a cultural environment is likely to result in substantial non-compliance, i.e. IUU fishing and failure of the management system.

Uncertainty about social change and the destabilization of a community can create enormous barriers to being able to address overcapacity. There may be many incorrect perceptions about what capacity reduction programmes can and cannot do and the impacts that they may or may not have. Thus, education is a key element for overcoming uncertainty and creating programme support.

In addition to concerns about changes and the uncertainties of what the future may bring, there may be concerns about social justice and issues of mistrust amongst the parties involved. The community will know that there will be so-called "winners" and "losers" as the result of a capacity reduction programme, but the community will likely be unclear about actually who will be the "winners" and "losers" and about the extent to which the winners may "win" and the losers may "lose". Concerns that "losers" will not be suitably or adequately compensated will likely contribute to resistance to adjustment programmes.

To try to address and to overcome such concerns when developing capacity management programmes, States should work with the communities and the fishers.

### 6.3 Legal considerations

As noted above, managing capacity involves limiting and/or clarifying the right of access to the resource. Issues relating to the definition of access or other property rights, historical rights, takings, and constitutional rights may all affect what may or may not be considered as options for capacity reduction programmes. These considerations will vary from State to State and from jurisdiction to jurisdiction.

There may be practical limits on the power or abilities of a fisheries management agency to design or implement a capacity reduction programme. There may be existing legislation that limits the types of options that could be suggested and designed. Similarly, other legislation for other purposes may have to be considered, taken into account, or even specifically addressed and, thus, influence the options for capacity reduction programme or the details of a particular programme's design. Examples may include endangered species legislation, labor legislation and financial legislation.

The problems of monitoring, control and surveillance are not new; however, in implementing capacity management programmes, having adequate enforcement is critical, especially when it may take several years to see the benefits of supporting and participating in capacity reduction rules. Efforts to reduce illegal fishing are similarly important.

In addition, judicial and other dispute resolution systems are essential to achieving due process, but they can also hamper the implementation of capacity management programmes. There is a need to ensure that the participants in these systems are fully briefed and understand what is to many, the relatively new issue area of fisheries and fisheries management. Without this information, for example, the penalties and other punishments may not reflect the seriousness of the problems they are meant to address. It is also important to design capacity programmes in ways that do not allow a few participants to stall their implementation to the detriment of all other participants.

Even when there is interest and will to simplifying rules and regulations, driving change in a bureaucracy can be difficult. Complex legal frameworks and the time to write or change existing rules and regulations can slow or even stop the adoption of a capacity management programme. If there is a poor legal framework, it may need to be strengthened or otherwise clarified before capacity management strategies can be considered. Similarly, if there is a lot of bureaucracy, existing regulatory mechanisms and methods may make it difficult to introduce new, different or innovative programmes.

It is very important to create incentives for self regulation – by understanding the business realities of fishing and by building on local, traditional, and customary forms of compliance. In the short term, capacity reduction and capacity management options may need to reflect the practical realities of existing legal and enforcement budgets and penalty systems. However, this does not prevent longer term efforts to change legislation and to set up regulatory structures in ways that encourage flexibility and responsibilities.

Finally, it is normal that informal arrangements or other relationships between members of different sectors exist. If various constituent groups have objectives that are different from those of a capacity reduction or management plan, the groups may call upon these informal relationships to achieve their respective objectives, potentially creating conflicts or creating barriers to the adoption or implementation of a capacity programme. To try to overcome some of issues, knowledge building, information sharing, consensus building and transparency are priority considerations. Knowledge building, information sharing and constituency building may involve the building of consensus with stakeholders who are part of the legislative

processes at both local and national levels. This is especially true if there is a need to amend or to write new legislation.

### 6.4 Financial considerations

Developing and implementing capacity management plans does require financial resources, and sometimes these may be considerable. The development of such plans requires the collection of baseline information on the current state of the resource and the existing level of capacity, and research into the effects of different plans on the industry, resource and communities.

Some forms of capacity reduction – e.g. buyback programmes – also require substantial financial resources to catalyse the transition process and for subsequent management of the fishery. Capacity reduction programmes require more than a one-time, direct cost of a buy-back. Thus, it is important to know both how adjustment and subsequently management costs will be covered and/or recovered. In addition to such direct costs, it is important to clearly document the transfer and use of funds for capacity reduction, so that all stakeholders can clearly account for monies raised and spent.

An alternative to government-funded programmes is industry funding through cost recovery. The principle of "user pays" is one that civil society is frequently using when talking about natural resources. Thus, if remaining participants benefit from capacity reduction programmes, they may also be the ones who help to fund the adjustment process. In other situations, donor organizations, seeking to provide the community at large with the benefits of capacity reduction, may consider paying for the temporary benefits achieved through buy-back programmes. For the participants who exit a fishery, it is important to assist their transition to new activities and livelihoods.

Even in countries where funding is not a barrier in itself, budget priorities, within fisheries administrations and at broader government levels, may not consider the funding of buy-back programmes as a high priority. In countries where funding issues are extremely serious, buy-backs may not be considered a main concern when compared to other priorities. If the fishing industry is going to fund its own buy-back programme, then the current financial position of the participants will have a significant influence on the ability to self-finance this part of a capacity reduction programme.

The use of market based mechanisms – such as ITQs and landing taxes – shifts the financial burden of the adjustment from government to industry. These programmes may result in higher enforcement and monitoring costs, which, unless funded through cost recovery from the industry, will create an

added financial burden, but the increased profitability of the fishery is typically able to accommodate such a change.

States should give consideration to the financing of any capacity management programme – both the total costs required and also the source of the finance (i.e. government or industry). The ideas of coordinating capacity reduction research as a cost saving, setting priority areas for further capacity-related research, considering various capacity reduction approaches, and evaluating the costs of doing nothing are all related to the notion of providing the best possible policy advice as the basis on which to make capacity reduction decisions.

### 6.5 Political and institutional considerations

Capacity management plans require support form both the communities that they affect and also the politicians that have the ability to create the appropriate legal and institutional framework (and potentially supply the appropriate financial resources also).

The challenges of overcoming problems such as those associated with capacity reduction programmes are difficult ones that may not be political priorities, politically expedient or timely. Elections, party issues, and political will are issues that can work to create political support for capacity reduction programmes, but these issues can also result in the postponement of political support until more opportune times.

Many potentially significant political concerns associated with capacity reduction programmes will reflect the current widespread lack of understanding about the impacts and issues of addressing overcapacity. Constituents' incomplete knowledge, perceptions and fears about change will also likely create areas of concern for politicians if there is little or no guidance offered about the impacts, changes, and benefits of addressing overcapacity as part of justifying the need for capacity reduction programmes.

The financial and social costs of capacity reduction programmes, especially in the short term, are likely to create political discomfort unless capacity reduction programmes are designed to include ways of addressing these issues.

Building community support for capacity management is perhaps the most effective means of obtaining political support. If industry and other constituencies are supportive of a capacity reduction programme, this can help to overcome concerns that politicians may have about achieving their political objectives and mandates. In some cases, it may be more powerful

or successful to ensure that industry is on-side and informed than to work on the political side of things. However, in other cases, the political sector and angle may be stronger and be able to over-ride pressure groups.

The different costs of overcapacity – to society at large, to fishers, to future generations – as well as the immediate costs to the fishing industry, consumers and other sectors need to be clearly explained as part of the process of recognizing and reducing political fears about capacity reduction programmes.

Politicians' understanding and knowledge of the complexities of capacity reduction programmes can be greatly enhance if both the costs of doing nothing and the elements and costs of the long term problems of overcapacity are fully and clearly explained. This knowledge sharing process should include an explanation of all the various angles and elements of capacity reduction programmes, including clear information about the so-called "winner", "losers", and what will happen to them.

### 6.6 Management and managerial considerations

Information and analysis that *supports* fisheries management is increasingly necessary. This is especially important because, in the absence of user rights, the incentives that cause participants' behavior are counter-intuitive and not like those in agriculture or other businesses. To meet information and analytical requirements, it is important to have structured and prioritized research programmes that freely and transparently share information and data. In addition, it is increasingly important to use socio-bio-economic models that reflect the real complexities and human elements of capacity reduction programmes.

Weaknesses in enforcement as well as the lack of enforcement capabilities can pose significant barriers to capacity reduction programmes, especially if the reduction programmes rely on incentive blocking measures and fail to motivate participants to enforce themselves. In terms of compliance, it is important to reduce the incentives that currently encourage fishers to overcapitalize. In addition, the use of standardized mechanisms for conflict resolution as well as current technologies for enforcement will help to alleviate management concerns.

Multiple, and typically conflicting, management objectives can be found in fisheries legislation and in the objectives that fisheries managers may have. It is important to work on possible ways in which to meet multiple objectives, but it may not be reasonable to expect that these differences can be equally and perfectly resolved. Thus, the use of mechanisms for conflict

resolution as well as determining different user groups' preferences and priorities will allow different groups to make trade-offs.

### 6.7 Natural disasters

Natural disasters such as hurricanes and tsunamis can have a devastating impact on both fishers and their coastal communities. For example, in Sri Lanka and Aceh (Indonesia), between 70-80 percent of the coastal fishing boats were destroyed as a result of the tsunami in December 2004.

Such disasters can be either platforms for catalyzing management changes, or they can inspire aid packages that exacerbate or create new capacity problems. For example, aid directed at enabling communities in these countries was intended to help them rebuild themselves and contained provisions for the replacement of fishing vessels destroyed in the disaster. For the fisheries already experiencing overcapacity, replacing the destroyed vessels without introducing limited entry and capacity management programmes created the opportunity for overexploitation of the marine resources.

While investment in the communities following natural disaster is essential if the coastal communities are to recover, States should remain cognizant of the potential problems of complete fleet replacement and consider alternative investment opportunities that may enable the coastal communities to diversify their activities into areas other than fishing. This is a complex, and politically sensitive, issue.

## 7. BUILDING INSTITUTIONAL CAPACITY

For many countries, capacity management and measurement will be a relatively new activity. Although considerable attention has been given to development of different measures of capacity, this research has been limited to relatively few countries. Consequently, for many States, there is a need to develop institutional capacity in order to allow them to adequately measure and assess capacity and to develop appropriate management measures.

Institutional capacity is the combination of skill, knowledge and information held by the organization, and is largely embedded in human capital (i.e. the staff) (Figure 11). Enhancing human capital involves engaging in economic and social research, training, and international collaboration. There is also a continuing need by all States to recognize how fishing capacity relates to various input levels, and how fishing capacity adjusts to differing incentives created by capacity management plans and other management interventions.

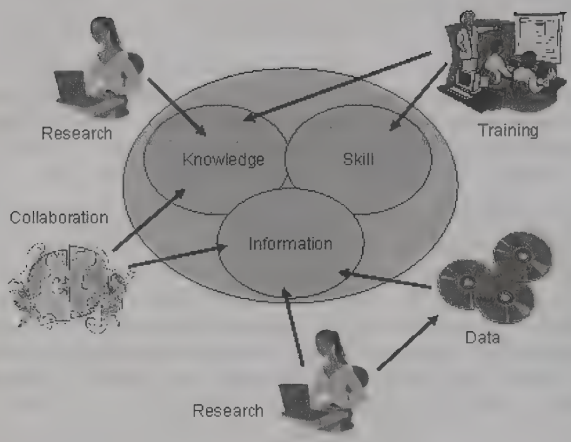


**Figure 11. Components and development of institutional capacity**

### 7.1 Training needs

The IPOA-Capacity calls for States to support training and institutional strengthening and to consider providing financial, technical and other assistance to developing countries on issues related to the management of fishing capacity. The review of the implementation of the IPOA (FAO, 2004a) found that several States identified the need for workshops and training in the areas of capacity management as well as in the various relevant supporting areas of monitoring, control and surveillance (MCS), capacity measurement, and stock assessment.

Training need not be limited to capacity management directly. Enhanced training in fisheries management and economics would enable managers and scientists to have a better understanding of how management measures influence how fishers and their fisheries work.

Training needs to be provided to all stakeholders, not just scientists and managers.[22] This also extends to training stakeholders in fisheries

[22] States should also consult FAO Fisheries Circular No. 1003: Human capacity development in fisheries (Macfadyen and Huntington, 2004), which outlines

management, science and economics in general, not just on capacity management issues. Stakeholder participating has been identified as an important consideration when designing and implementing capacity management plans. For effective stakeholder engagement, they need to be familiar with the key principles relating to fisheries and capacity management, including the implications of different management instruments. Stakeholder representatives may also need to be trained in more generic management skills, as they will also need to communicate with their constituent membership group as well as fisheries managers, scientists and economists. Training in aspects of community organization contributes to the strengthening of individuals and their associations, enabling them to interact more efficiently between themselves and with government institutions (Hartmann and Campelo, 1998).

Training in of these aspects can be provided through either domestic or overseas universities or institutes, or through inviting international experts to provide training courses in situ. States need to identify their key training needs and the most cost-effective methods for obtaining appropriate training.

## 7.2 Research needs

Research will need to be undertaken it two key areas. First, research is required to provide the basic information needed to manage capacity. These include stock assessments, measurement of capacity, and determining the links between inputs and outputs. Second, research is required to determine the likely outcomes of alternative capacity management systems, which may change from fishery to fishery. This includes consideration of the behavior of fishers and fishery specific characteristics (biological, geographical or economic).

### *7.2.1 Basic information needs*

Basic research needs to be undertaken to assess the biological and economic status of the different fisheries. This includes collection of catch and effort data (i.e. monitoring) as well as economic data. Ideally, States should aim to collect Level 4 information (see Table 1). Where this is not currently feasible, States should develop data collection programmes to collect as high a level of information as possible, and develop a plan to collect higher level information in the future.

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training needs for different stakeholder groups relating to capacity management as well as other aspects of fisheries management.

Basic research also includes stock assessments and economic performance measures, as well as into the other qualitative indicators described in Section 4.2.

Where possible (i.e. depending on the level of data availability), States should undertake research to quantitatively measure and assesses capacity in their fisheries. As each fishery is different, States should also undertake methodological research to help develop appropriate measures of capacity. These might include:

- conducting case studies on the measurement of fishing capacity (using various methods) and the determination of target capacity levels and paths, with a view to determining the most appropriate techniques and units of measurement for their particular fisheries. These studies should also include examination of the usefulness of various indicators, particularly in the context the case of small-scale fisheries and developing countries;
- developing more advanced methods for the systematic assessment of fleet characteristics and dynamics with a view to better understanding of fundamental patterns related to fishing capacity;
- assessing, in relation to fleet mobility, the significance and effects of international and national spillover of fishing capacity;
- designing and implementing comprehensive fleet assessment programmes, using more advanced methods developed for this purpose, while ensuring the continuity of efficient resource assessment; and
- assessing investment in fish harvesting capacity and sectoral dynamics, with emphasis on assessing the evolution of capital intensity and related dynamics; and on describing the degree to which capacity issues in the processing industry, as well as market dynamics, affects capacity in the fishing sector.

The development of bioeconomic models of key fisheries is also an important area for research. These are important to help define target levels of capacity, but also act as a communication tool between different stakeholders. A quantitative model forces the assumptions, biases and misunderstandings of all stakeholders to be made transparent. In doing so, misperceptions of scientists, industry members and other stakeholders can be corrected. Without a quantitative model, these assumptions and perceptions are less transparent, resulting in less "buy-in" to the management proposal.

A further area for empirical research is in the relationship between inputs and outputs itself. The main objective of capacity management is to balance the level of fleet inputs with the sustainability of the resource, so information on the relationship between input levels and resulting catch levels is fundamental to determining both target capacity and capacity management goals. Further, where fisheries are managed by input controls, knowledge of how changes in input levels affect catch, and the extent to which regulated inputs can be substituted for unregulated inputs, is essential. States need to sponsor research to provide understanding of the relationship between inputs and outputs in their major fisheries so that a coherent policy towards capacity management can be developed.

### *7.2.2 Capacity management research*

A further area where research is required concerns the applicability of the alternative management instruments to the national fisheries. Empirical research could usefully be undertaken on the adaptation of existing instruments to particular fishery management situations, for instance developing workable TURF or co-management systems for small-scale fisheries. Studies that States may wish to consider include research into:

- understanding the mechanisms, advantages and disadvantages of co-management and community-based fisheries management as frameworks for controlling fishing capacity;
- assessing the use of taxes and royalties in relation to the control of fishing capacity, with focus on impact, use and methods;
- conducting studies of buy-back programmes so as to ascertain the conditions under which they can be effective in decreasing capacity on a sustained basis; and
- managing fishing capacity for small-scale fisheries, with special reference to methods and approaches which may be most appropriate, and to community-based mechanisms in particular.

Overcapacity is an industry-level problem, but is a result of individual fishers responding to the set of incentives with which they are faced. Dealing with capacity, therefore, requires a good understanding of the economic behaviour of fishers. Research could usefully be undertaken to illuminate the incentives, both macroeconomic and sectoral, that fishers face in particular fisheries. The identification of such incentives would allow States to avoid counter-productive policies, which would already be a significant advance.

States should also facilitate research into the industrial and managerial economics of fishing enterprises in general so as to enhance such understanding and enable the development of measures to deal with overcapacity that are compatible with the economic strategies of fishers.

### 7.3 Scientific cooperation

The IPOA-Capacity calls for States to support the exchange of scientific and technical information on issues related to the management of fishing capacity and promote its world-wide availability using existing regional and global fora.

The IPOA-Capacity also identified strengthening of regional fisheries management organizations (RFMOs) and related mechanisms for improved management of fishing capacity at regional and global levels as a major objective. Articles 27 through 38 of the IPOA are concerned with regional collaboration and participation in international agreements that relate to the management of fishing capacity. This collaboration is at two levels: first, in relation to shared or straddling stocks; and second, in relation to high seas fishing. For high seas and straddling stock fisheries, scientific cooperation is particularly important. Determining current and target capacity in such fisheries requires harmonized data collection and reporting by all States involved in these fisheries.

### 7.4 Physical capital

The focus of the above discussion has been development of human capital in order to develop and implement appropriate capacity management strategies. However, effective capacity management may also need investment in physical capital, something needed for fisheries management in general, so are not specific to capacity management.

At a fundamental level, manager and researchers aimed at supporting management require access to data. Data can also be considered a capital item, as its collection involves the use of resources to produce, and it is productive value increases with both the quantity and frequency of data collection. While data collection and analysis has been discussed above, effective use of information requires access though databases and appropriate computer software and hardware. Collection of detailed data is of little use if it cannot be readily used by managers or researchers. Again, these systems are required for fisheries management in general, so are not specific to capacity management.

In all fisheries, effective MCS systems are necessary to ensure that any management measures implemented in the fishery to manage capacity are

adhered to. As noted previously, any control affects the incentives facing fishers. While all fishers may benefit if all adhere to the rules, individuals may achieved greater benefits by not adhering to the rules, provided that the others do. Without an effective MCS system, it is likely that the regulations will not be adhered to and the expected benefits not achieved.

### 7.5 Legal frameworks

The need for a robust legal framework has been highlighted already in Section 6.3. It is worth re-iterating this need, as without a strong legal framework managers will be unable to introduce effective capacity management plans. National fisheries policy makers should ensure that the legal frameworks in place in each State are sufficient to enable managers to design, implement, monitor and operate effective capacity management programmes.

Details on the development of an effective legal framework are provided in Section 4.3 of the FAO Technical Guidelines for Responsible Fisheries No. 4 *Fisheries management*. States are recommended to review these Guidelines also when developing capacity management plans.

## 8. SUMMARY OF KEY ACTIONS

There are a number of actions for States to consider when developing and implementing an NPOA-Capacity. These are summarized below.

Developing a national definition of fishing capacity

- States should adopt a national definition of fishing capacity. Whilst fishing capacity may be estimated as either an input based measure or an output based measure, it may be useful to express fishing capacity estimates on both bases, especially where fisheries extend to other jurisdictions.
- States should coordinate with adjacent States in order to determine a consistent definition of fishing capacity where fisheries extend to other jurisdictions.

Stakeholder engagement

- The development of the NPOA-Capacity and capacity management plans should involve stakeholders at every stage. Management should be seen as a partnership between the management authority and the different interest groups. In general terms, States should consider the strong involvement of the fishing sector in the process of managing fishing capacity as essential.

- The process of identifying and agreeing objectives both for a NPOA-Capacity and for specific capacity management plans should involve the key stakeholder groups that will be affected by capacity management strategies. This may include non-fishery as well as fishery interest groups.

- In developing policies for the management of fishing capacity, States should undertake extensive consultations with the industry and other stakeholders and seek consensus on capacity management issues and methods.

Capacity assessment, measuring and monitoring

- States should undertake to assess the current and desired (i.e. target) capacity in each fishery and fleet segment. The assessment of the current level of capacity should include, where feasible, both a qualitative and a quantitative review of fishing capacity.

- States should remain cognizant of the precautionary principles relating to the management of fisheries and the marine environment. Given the uncertainty inherent in fisheries analyses, States should generally aim at lower levels of target capacity and avoid fishing capacity targets that may result in high effort levels and lower yields.

- States should develop and maintain appropriate and compatible national records of fishing vessels in line with the standards being developed by FAO.

- Effective monitoring, control and surveillance systems are necessary to ensure that the measures implemented in the fishery to manage capacity – either input- or output-based approaches - are adhered to. States should specify how capacity management plans are to be monitored and enforced.

- Fishing capacity should be monitored independently of the management measures chosen.

Choice of management instrument

- States should identify, for each fishery, how the target fishing capacity is to be achieved. This involves identifying which management approaches are to be employed and how the management instruments are to be implemented.

- States should aim to adopt measures that are both effective and promote economic efficiency. Where possible, measures that create

incentives for the fishery to self-adjust in response to changes in the natural, economic or social environment should be implemented.

Transitional and institutional issues

- States should work with their communities and the fishing industry sector to address the transitional issues and concerns identified in the Guidelines, both when developing a NPOA-Capacity and capacity management plans.
- States should consider the legislative frameworks within which fisheries management plans are to be formulated and implemented. Where possible, support to changing these frameworks needs to be provided.
- States should give consideration to the financing of capacity management programmes and transitional phases – both in terms of the total costs required and also the source(s) of the finance (i.e. government, industry, and/or other sectors).

Capacity building

- Training in capacity management needs to be provided to all fisheries stakeholders, not just scientists and fisheries managers. Training needs include all areas of capacity management, including measurement, assessment, monitoring and implementation. All stakeholder groups should also have a thorough understanding of the different management instruments available for capacity management.
- States should undertake research to both qualitatively and quantitatively measure and assesses capacity in their fisheries.
- States should also facilitate research into the industrial and managerial economics of fishing enterprises in general so as to enhance such understanding and enable the development of measures to deal with overcapacity that are compatible with the economic strategies of fishers.

Subsidies

- IPOA-Capacity calls for States to reduce and progressively eliminate subsidies and economic incentives contributing directly or indirectly to the build-up of excessive fishing capacity.
- States should undertake a national review of the various subsidies and other economic incentives being provided to their fishing

industry, together with a qualitative assessment of their likely impact on fishing capacity, fishers' expected investment decisions and the ability of the fisheries resources to be sustainable.

International fisheries

- States should collaborate with RFMOs by sharing information, participating in and developing harmonized systems of data collection, and supporting the actions of the respective RFMOs to limit fishing capacity in international waters.

- Fisheries authorities should assess the impact that may be caused by a significant reallocation of overcapacity to the EEZ of another State and, if potentially detrimental, should take steps to discourage such transfers whenever possible. The IPOA-Capacity requests that States ensure that no transfer of capacity to the jurisdiction of another State should be carried out without the express consent and formal authorization of that State.

- States should comply with existing international agreements that are aimed at addressing the problem of fishing in international waters directly. These include the Compliance Agreement and the Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks (the 1995 UN Fish Stock Agreement).

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## Appendix 1: FAO International Plan of Action for the Management of Fishing Capacity (IPOA-IUU)

### Introduction

1. In the context of the Code of Conduct for Responsible Fisheries and its overall objective of sustainable fisheries, the issues of excess fishing capacity in world fisheries is an increasing concern. Excessive fishing capacity is a problem that, among others, contributes substantially to overfishing, the degradation of marine fisheries resources, the decline of food production potential, and significant economic waste.

2. The Code of Conduct provides that States should take measures to prevent or eliminate excess fishing capacity and should ensure that levels of fishing effort are commensurate with sustainable use of fishery resources.

3. At its last Session in 1997, the Committee on Fisheries (COFI), requested FAO to address the issue of fishing capacity. FAO organized a Technical Working Group on the Management of Fishing Capacity in La Jolla, USA, from 15 to 18 April 1998. A subsequent FAO consultation was held in Rome from 26 to 30 October 1998, preceded by a preparatory meeting from 22 to 24 July 1998.

*Part I - Nature and Scope of the International Plan of Action*

4. The International Plan of Action is voluntary. It has been elaborated within the framework of the Code of Conduct for Responsible Fisheries as envisaged by Article 2 (d). The provisions of Article 3 of the Code apply to the interpretation and application of this International Plan of Action and its relationship with other international instruments.

5. This document is in furtherance of the commitment of all States[1] to implement the Code of Conduct. States and regional[2] fisheries organizations should apply this document consistently with international law and within the framework of the respective competencies of the organizations concerned.

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[1] In this document, the term "State" includes Members and non-members of FAO and applies *mutatis mutandis* also to "fishing entities" other than States.

[2] In this document, the term "regional" includes subregional, as appropriate.

6. The International Plan of Action constitutes an element of fishery conservation and sustainable management.

*Part II - Objective and Principles*

7. The immediate objective of the International Plan of Action is for States and regional fisheries organizations, to achieve world-wide preferably by 2003, but not later than 2005, an efficient, equitable and transparent management of fishing capacity. *Inter alia*, States and regional fisheries organizations confronted with an overcapacity problem, where capacity is undermining achievement of long-term sustainability outcomes, should endeavour initially to limit at present level and progressively reduce the fishing capacity applied to affected fisheries. Where long-term sustainability outcomes are being achieved, States and regional fisheries organizations nevertheless need to exercise caution to avoid growth in capacity undermining long-term sustainability objectives.

8. The above objective may be achieved through a series of actions related to four major strategies:

i. the conduct of national, regional and global assessments of capacity and improvement of the capability for monitoring fishing capacity;

ii. the preparation and implementation of national plans to effectively manage fishing capacity and of immediate actions for coastal fisheries requiring urgent measures;

iii. the strengthening of regional fisheries organizations and related mechanisms for improved management of fishing capacity at regional and global levels;

iv. immediate actions for major transboundary, straddling, highly migratory and high seas fisheries requiring urgent measures.

These strategies may be implemented through complementary mechanisms to promote implementation of this international Plan of Action: awareness building and education, technical co-operation at the international level, and co-ordination.

9. The management of fishing capacity should be based on the Code of Conduct for Responsible Fisheries and take into consideration the following major principles and approaches:

i. *Participation*: The International Plan of Action should be implemented by States either directly, in co-operation with other States, or through FAO in co-operation with other appropriate intergovernmental organizations, including regional fisheries organizations. States and regional fisheries organizations, as appropriate, are encouraged to give effect to it and to inform FAO of actions taken to implement it. FAO will regularly provide information about its implementation.

ii. *Phased implementation:* The management of fishing capacity on the basis of national and regional plans should be achieved through the following three phases: assessment and diagnosis (preliminary analysis to be completed by the end of 2000), adoption of management measures (preliminary steps to be adopted by the end of 2002) and periodic adjustment of such assessment and diagnosed measures, as appropriate. States and regional fisheries organizations should complete these steps and progressively implement by 2005 the complementary measures specified in the International Plan of Action.

iii. *Holistic approach:* The management of fishing capacity should consider all factors affecting capacity in both national and international waters;

iv. *Conservation:* The management of fishing capacity should be designed to achieve the conservation and sustainable use of fish stocks and the protection of the marine environment consistent with the precautionary approach, the need to minimize by-catch, waste and discard and ensure selective and environmentally safe fishing practices, the protection of biodiversity in the marine environment, and the protection of habitat, in particular habitats of special concern.

v. *Priority:* Priority should be given to managing the fishing capacity in those fisheries in which there already unequivocally exists overfishing;

vi. *New technologies:* The management of fishing capacity should be designed so that it takes into account the incorporation of environmentally sound and evolving technology in all areas of capture fisheries.

vii. *Mobility:* The management of fishing capacity should encourage efficient use of fishing capacity and discourage mobility when it negatively affects sustainability and take due account of socio-economic performances in other fisheries;

viii. *Transparency*: The International Plan of Action should be implemented in a transparent manner in accordance with Article 6.13 of the Code of Conduct.

10. The implementation of the International Plan of Action should be based on the Code of Conduct, particularly Article 5, in relation to enhancing the ability of developing countries, to develop their own fisheries as well as to participate in high seas fisheries, including access to such fisheries, in accordance with their legitimate rights and their obligations under international law.

*Part III - Urgent Actions*

**Section I: Assessment and monitoring of fishing capacity**

***Measurement of fishing capacity***

11. States should support coordinated efforts and research at national, regional and global levels to better understand the fundamental aspects of issues related to the measurement and monitoring of fishing capacity.

12. States should support the organization by FAO of a technical consultation to be held as early as possible in 1999 on the definition and measurement of fishing capacity and the subsequent preparation of technical guidelines for data collection and analysis, noting that the result of this consultation should provide specific guidance for preliminary assessments of fishing capacity and excess fishing capacity at national, regional and global levels.

***Diagnosis and identification of fisheries and fleets requiring urgent measures***

13. States should proceed, by the end of 2000, with a preliminary assessment of the fishing capacity deployed at the national level in relation to all the fleets of principal fisheries and update this assessment periodically.

14. States should proceed, by the end of 2001, with the systematic identification of national fisheries and fleets requiring urgent measures and update this analysis periodically.

15. States should cooperate, within the same time frame, in the organization of similar preliminary assessments of fishing capacity at the regional level (within the relevant regional fisheries organizations or in collaboration with them, as appropriate) and at the global level (in collaboration with FAO) for transboundary, straddling, highly migratory and high seas fisheries, as well as in the identification of regional or global fisheries and fleets requiring urgent measures.

***Establishment of records of fishing vessels***

16. States should support FAO in the development of appropriate and compatible standards for records of fishing vessels.

17. States should develop and maintain appropriate and compatible national records of fishing vessels, further specifying conditions for access to information.

18. While awaiting the entry into force of the Agreement to Promote Compliance with International Conservation and Management Measures by Fishing Vessels on the High Seas (Compliance Agreement), States should support the establishment by FAO by the end of 2000 of an international record of fishing vessels operating in the high seas, following the model indicated in the Compliance Agreement.

**Section II: Preparation and implementation of national plans**

***Development of national plans and policies***

19. States should develop, implement and monitor national plans of action for managing fishing capacity, taking into account, *inter alia,* the effect of different resource management systems on fishing capacity.

20. States should develop the means to monitor fishing capacity systematically and accurately, and to regularly assess any imbalance with available fishery resources and management objectives.

21. States should develop, adopt and make public, by the end of 2002, national plans for the management of fishing capacity and, if required, reduce fishing capacity in order to balance fishing capacity with available resources on a sustainable basis. These should be based on an assessment of

fish stocks and giving particular attention to cases requiring urgent measures and taking immediate steps to address the management of fishing capacity for stocks recognized as significantly overfished.

22. States should give due consideration, in the development of national plans, to socio-economic requirements, including the consideration of alternative sources of employment and livelihood to fishing communities which must bear the burden of reductions in fishing capacity.

23. When it has been found that a national plan to manage capacity is not necessary, States should ensure that the matter of fishing capacity is addressed in an ongoing manner in fishery management.

24. At least every four years, States should review the implementation of their national plans to manage capacity for the purpose of identifying cost effective strategies for increasing effectiveness.

***Subsidies and economic incentives***

25. When developing their national plans for the management of fishing capacity, States should assess the possible impact of all factors, including subsidies, contributing to overcapacity on the sustainable management of their fisheries, distinguishing between factors, including subsidies, which contribute to overcapacity and unsustainability and those which produce a positive effect or are neutral.

26. States should reduce and progressively eliminate all factors, including subsidies and economic incentives and other factors which contribute, directly or indirectly, to the build-up of excessive fishing capacity thereby undermining the sustainability of marine living resources, giving due regard to the needs of artisanal fisheries.

***Regional considerations***

27. States should cooperate, where appropriate, through regional fisheries organizations or arrangements and other forms of co-operation, with a view to ensuring the effective management of fishing capacity.

28. States should strive to collaborate through FAO and through international arrangements in research, training and the production of information and educational material aiming to promote effective management of fishing capacity.

**Section III: International considerations**

29. States should consider participating in international agreements which relate to the management of fishing capacity, and in particular, the Compliance Agreement and the Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks.

30. States should support co-operation and the exchange of information among all regional fisheries organizations in accordance with their procedures.

31. States should take steps to manage the fishing capacity of their vessels involved in high seas fisheries and cooperate, as appropriate with other States, in reducing the fishing capacity applied to overfished high seas stocks.

32. States should improve, through regional fisheries organizations where appropriate, and in collaboration with FAO, the collection of data on catches on the high seas as well as in the coastal area by their fleet.

33. States should recognize the need to deal with the problem of those States which do not fulfil their responsibilities under international law as flag States with respect to their fishing vessels, and in particular those which do not exercise effectively their jurisdiction and control over their vessels which may operate in a manner that contravenes or undermines the relevant rules of international law and international conservation and management measures. States should also support multilateral co-operation to ensure that such flag States contribute to regional efforts to manage fishing capacity.

34. States should be encouraged to become members of regional fisheries organizations or arrangements, or agree to apply the conservation and management measures established by such organizations or arrangements to their vessels.

35. States should promote, with the assistance of FAO, the exchange of information about the fishing activity of vessels which do not comply with conservation and management measures adopted by regional fisheries organizations and arrangements, consistent with Article VI of the Compliance Agreement.

36. Anticipating the entry into force of the Compliance Agreement, States should strive to apply the provisions of Article III of that Agreement.

37. States should ensure that no transfer of capacity to the jurisdiction of another State should be carried out without the express consent and formal authorization of that State.

38. States should, in compliance with their duties as flag States, avoid approving the transfer of vessels flying their flag to high seas areas where such transfers are inconsistent with responsible fishing under the Code of Conduct.

**Section IV: Immediate actions for major international fisheries requiring urgent measures**

39. States should take immediate steps to address the management of fishing capacity for international fisheries requiring urgent attention, with priority being given to those harvesting transboundary, straddling, highly migratory and high seas stocks which are significantly overfished.

40. Within the framework of their respective competencies, States should act individually, bilaterally and multilaterally, as appropriate, to reduce substantially[3] the fleet capacity applied to these resources as part of management strategies to restore overfished stocks to sustainable levels considering, in addition to the other relevant provisions of the International Plan of Action:

i. the economic importance of the fleets catching overfished stocks and the need to limit these fleets to a level commensurate with stock sustainability and economic viability; and

ii. the use of appropriate measures to control the transfer of overcapacity to fully exploited or overexploited fisheries, taking into consideration the condition of the fish stocks.

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[3] The required reduction would vary from fishery to fishery; e.g. a 20 to 30% reduction was mentioned for large-scale tuna long line fleet (Report of the FAO Technical Working Group on the Management of Fishing Capacity. La Jolla, United States of America, 15-18 April 1998. FAO Fisheries Report No. 586).

*Part IV - Mechanisms to Promote Implementation*

41. States should develop information programmes at national, regional and global levels to increase awareness about the need for the management of fishing capacity, and the cost and benefits resulting from adjustments in fishing capacity.

***Scientific and technical cooperation***

42. States should support the exchange of scientific and technical information on issues related to the management of fishing capacity and promote its world-wide availability using existing regional and global fora.

43. States should support training and institutional strengthening and consider providing financial, technical and other assistance to developing countries on issues related to the management of fishing capacity.

***Reporting***

44. States should report to FAO on progress on assessment, development and implementation of their plans for the management of fishing capacity as part of their biennial reporting to FAO on the Code of Conduct.

***Role of FAO***

45. FAO will, as and to the extent directed by its Conference, collect all relevant information and data which might serve as a basis for further analysis aimed at identifying factors contributing to overcapacity such as, *inter alia,* lack of input and output control, unsustainable fishery management methods and subsidies which contribute to overcapacity.

46. FAO will, as and to the extent directed by its Conference, and as part of its Regular Programme activities, support States in the implementation of their national plans for the management of fishing capacity.

47. FAO will, as directed by its Conference, support development and implementation of national plans for the management of fishing capacity through specific, in-country technical assistance projects with Regular Programme funds and by use of extra-budgetary funds made available to the Organization for this purpose.

48. FAO will, through COFI, report biennially on the state of progress in the implementation of the International Plan of Action.

**Appendix 2: FAO reports linked to the IPOA-Capacity (1999–2007)**

| Substantive area of the IPOA–Capacity | FAO reports |
|---|---|
| Definition of fishing capacity | Gréboval D. (ed.). 1999. Managing fishing capacity: selected papers on underlying concepts and issues. FAO Fisheries Technical Paper No. 386. Rome. |
| Measurement of fishing capacity | FAO. 2000. Report of the Technical Consultation on the Measurement of Fishing Capacity, Mexico City, Mexico, 1999. FAO Fisheries Report No. 615. Rome.<br><br>Pascoe, S. and D. Gréboval (eds). 2003. Measuring Capacity in Fisheries: Selected Papers. FAO Fisheries Technical Paper No. 445. Rome.<br><br>Pascoe, S., J.E. Kirkley, D. Gréboval and C.J. Morrison Paul. 2003. Measuring and Assessing Capacity in Fisheries: Issues and Methods. FAO Fisheries Technical Paper No. 433/2. Rome.<br><br>Ward, J.M., Kirkley, J.E., Metzner, R. and S. Pascoe. 2004. Measuring and assessing capacity in fisheries. 1. Basic concepts and management options. FAO Fisheries Technical Paper No. 433/1. Rome.<br><br>Pascoe, S., Gréboval, D., Kirkley, J. and Lindebo, E. 2004. Measuring and appraising capacity in fisheries: framework, analytical tools and data aggregation. FAO Fisheries Circular No. 994. Rome. |
| Effects of fisheries management strategies on capacity | Gréboval, D. and G. Munro. 1999. Overcapitalization and Excess Capacity in World Fisheries: Underlying Economics and Methods of Control. In Dominique Gréboval (ed.), Managing Fishing Capacity. FAO Fisheries Technical Paper No. 386. Rome.<br><br>Cunningham, S. and D. Gréboval. 2001. Managing Fishing Capacity: A Review of Policy and Technical Issues. FAO Fisheries Technical Paper No. 409. Rome.<br><br>Ward, J.M. and R. Metzner. 2002. Fish Harvesting Capacity, Excess Capacity, and Overcapacity: A Synthesis of Measurement Studies and Management Strategies. FAO Fisheries Report No. 691. Rome. |

| Substantive area of the IPOA–Capacity | FAO reports |
|---|---|
| | Gréboval, D. (comp.) 2002. Report and documentation of the International Workshop on Factors Contributing to Unsustainability and Overexploitation in Fisheries. Bangkok, Thailand, 4–8 February 2002. FAO Fisheries Report. No. 672. Rome. |
| Transitioning away from overcapacity | Metzner, R. and J.M. Ward. 2002. Report of the Expert Consultation on Catalysing the Transition away from Overcapacity in Marine Capture Fisheries. FAO Fisheries Report No. 691. Rome. |
| Regional capacity management case studies and reviews | Joseph, J. 2003. Managing Fishing Capacity of the World Tuna Fleet. FAO Fisheries Circular No. 982. Rome.<br><br>Gréboval, D. and F. Poulain (eds). 2003. Rapport et documentation de l'Atelier de réflexion sur la gestion des capacités de pêche en Afrique de l'Ouest. FAO Fisheries Report No. 707. Rome.<br><br>FAO/ADRIAMED. 2004. AdriaMed Seminar on Fishing Capacity: Definition, Measurement and Assessment. FAO-MiPAF Scientific Cooperation to Support Responsible Fisheries in the Adriatic Sea. GCP/RER/010/ITA/TD-13. AdriaMed Technical Document No. 13.<br><br>FAO/FishCode. 2005. Report of the National Seminar on the Reduction and Management of Commercial Fishing Capacity in Thailand. Cha-Am, Thailand, 11-14 May 2004. FAO/FishCode Review No. 13. Rome.<br><br>FAO. 2004. Report of the Technical Consultation to Review Progress and Promote the Full Implementation of the International Plan of Action to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated Fishing and the International Plan of Action for the Management of Fishing Capacity. Rome, 24–29 June 2004. FAO Fisheries Report No. 753. Rome.<br><br>Bayliff, W.H., de Leiva Moreno, J.I. and J. Majkowski (eds.). 2005. Second Meeting of the Technical Advisory Committee of the FAO Project "Management |

| Substantive area of the IPOA–Capacity | FAO reports |
|---|---|
| | of Tuna Fishing Capacity: Conservation and Socio-economics". Madrid, Spain, 15–18 March 2004. FAO Fisheries Proceedings No. 2. Rome. |
| Regional capacity management case studies and reviews | FAO Fisheries Department and FAO Subregional Office for Southern and East Africa. 2005. Report of the First Lake Victoria Fisheries Organization and FAO Regional Technical Workshop on Fishing Effort and Capacity on Lake Victoria. Dar es Salaam, United Republic of Tanzania, 12–14 December 2005. FAO Fisheries Report No. 796. Rome. |
| | FAO. (In preparation). Report of the Lake Victoria Fisheries Organization and FAO National Stakeholders' Workshops on Fishing Effort and Capacity on Lake Victoria (2006). FAO Fisheries Report No. 817. Rome. |
| | FAO. (In preparation). Report of the Lake Victoria Fisheries Organization and FAO Regional Stakeholders' Workshop on Fishing Effort and Capacity on Lake Victoria (2006). FAO Fisheries Report No. 818. Rome. |

## Appendix 3: Different management systems and their implications for capacity

Capacity management is one of the fundamental elements of fisheries management. As such, most fisheries management measures can be used for capacity management because no single management tool will likely prove successful if used in isolation. However, many management measures are often introduced to achieve other objectives and may have varying success when implement to achieve capacity management objectives, so it is important to know how they will also affect fishing capacity in a fishery.

Management measures that have been used for trying to manage fishing capacity may be classified as either incentive blocking or incentive enhancing systems. This refers to the impact on the incentives facing the fishers. Incentive blocking programmes impose direct restrictions on the fishers activity, thereby blocking fishers' activities that what would otherwise occur if unregulated. Incentive enhancing systems provide incentives for fishers to behave in a manor that is consistent with the objectives of the programme. These systems have both costs and benefits, as outlined in Section 5.2.

An outline of the key capacity management measures is presented below. This has been summarized from FAO Fisheries Technical Paper 433/1.

### 3.1 Incentive-blocking programmes

#### *3.1.1 Limited entry*

Restricting entry to a fishery is the first step in addressing the open access problem, but license limitation is not – by itself – a sufficient management measure to reduce capacity. It requires other mechanisms to control fishing capacity because increases in capacity will increase as a result of fishers:

- capital stuffing – where the characteristics of a boats – e.g. its power or horsepower, length, breadth, and tonnage – are increased;
- changing in gear;
- changing in fishing periods or areas; and
- adopting technological innovations in fishing gear.

Licence limitation programmes can be modified to address the problems caused by capital stuffing by introducing transferable unitization systems and licence transferability. Licence transfers allow new entrants to come into a fishery when existing fishermen exit the fishery. While charges can be imposed for the issuance or transfer of licences that capture some of the

rents generated by the stock, this does not prevent capacity from increasing over the long term. The rate of increase of capacity is reduced, but it continues to increase over time.

Unitization (or fractional licence) programmes assign each participant in a limited entry fishery a number of capacity units based on the physical characteristics of the vessel (e.g. length, engine power and/or fishing gear units), and the total number of units in the fishery is capped. Under such programmes, new and/or larger boats can only be introduced through purchasing the units from other owners. Penalties on the upgrading of boats through the forfeiture of units may also partially compensate for the increases in capacity but may have negative safety consequences because they penalize fishers' use of better technologies. Consequently, with unitization programmes the total number of units may be reduced over time, but the actual capacity of the fleet may remain constant or increase if the forfeitures do not offset the increases in efficiency.

### *3.1.2 Buyback programmes*

Buyback programmes buy and remove boats, license s or vessel capacity units from a fleet as a means of decreasing capacity. While the programmes are designed to remove physical capacity (i.e. inputs), they are generally assumed also to reduce the harvesting capacity of the fleet – preferably by an equivalent amount. In some cases, they are also an implicit subsidy to the industry by creating a means for unviable firms to exit the industry and by helping remaining vessels become more economically viable, thereby providing economic assistance to the fishery and region.

Many countries have experience in operating buyback programmes, including Japan, the United States of America, Canada, Norway, Australia, those in the European Union, and Taiwan Province of China. Similar motivations and goals existed in each programme even though the mechanics differed. For example, some programmes purchased licenses instead of vessels, and others restricted license use or participation in commercial fishing.

The problem with buyback programmes is that the buyback programmes' potential to achieve their stated goals seemed very limited in actual practice (Holland *et al.*, 1999). In the short term, capacity may be reduced in a fishery. However, as long as (regulated) open access fishery incentives remain, improvements in stock abundance will attract additional capacity into the fishery. Thus, only if buybacks are used in conjunction with the implementation of rights-based management systems that correct market incentives will individual fishers be more likely to conserve their resource stocks including the stock of fish. In addition, the buyback programmes

would be more effective if the regulatory instrument that grants access to the fishery would also capture the resource rents.

Some vessel buyback programmes have worked very well, but those that have worked well have generally been introduced as an integral part of a rights-based management system. In this context, a buyback programme can provide a solution to the problem of what to do with surplus vessels in a situation of generalized overcapacity. Examples of this include the Australian south-east fishery, which incorporated a buyback programme with the introduction of an ITQ programme to facilitate adjustment to the new programme and the Bering Sea groundfish fishery. In both examples, the buyback programmes were industry funded.

### *3.1.3 Gear and vessel restrictions*

Gear and vessel restrictions attempt to control capacity by controlling how fishers are allowed to use inputs in the production of fishing effort, and these are effort controls rather than capacity controls per se. Gear restrictions include minimum mesh sizes, restrictions on the number of pots or traps, limits on the length of longlines, or bans on the use of certain gears or fishing methods. Vessel restrictions specify the physical characteristics of vessels (e.g., hull, hold and engine sizes).

As a temporary measure, gear and effort restrictions can reduce fishing mortality to target levels. However, over time, fishers can generally circumvent the regulations by substituting other factor inputs or new types of gear for the inputs that have been restricted. For example, regulations restricting the length of a vessel can be circumvented by increasing the boat's beam or by increasing its engine power. As a result, they impose inefficiency on the vessels, resulting in lower levels of profitability than might otherwise be possible, and they are ineffective in the long term in containing harvesting capacity.

### *3.1.4 Aggregate catch quotas*

Aggregate catch quotas are used to maintain or rebuild fish stocks by establishing a total allowable catch (TAC) for a fishery. Aggregate quotas are fished competitively rather than allocated to individuals.

If used in isolation, in virtually all situations TACs are more likely to speed up the growth of fishing capacity rather than reduce it (FAO, 1998). As stocks of fish recover because of reduced fishing mortality, rents appear and attract new capacity into the fishery through the entry of new fishers (if entry is not limited) or expansion of existing fishing effort. As a result, a race for fish or fishing derby develops, shorter fishing seasons are implemented to try to offset this, and harvesting costs are increased as

fishers work to land the same amount of fish in the shorter period of allowable fishing time. When approaching the limits of a binding TAC, sufficient real-time data may be difficult to obtain to use as a basis to close the fishery, resulting in frequent overruns of the TAC.

These large landings over short time periods also frequently result in requiring excessive processing capacity to handle these peak loads of fish. The results is overcapacity in the fishing sector, idle capacity in the processing sector, and it can exacerbate the seasonality of employment in both of these sectors.

### *3.1.5 Non-transferable vessel catch limits*

Individual vessel catch limits are a form of individual quota without transferability between fishers. As such, they partly address the property rights issue, but they do not allow any mechanism for capacity to adjust out of the fishery. As a consequence, the fundamental cause of overcapacity is not addressed, but the growth in additional overcapacity may be slowed. By restricting the amount of fish each individual fisher may land, the race for fish can be slowed. Staggered or tiered catch limits have been used in fisheries to allow full-time or specialist fishers higher catch limits than part-time or generalist fishers.

As with other regulations, fishers can circumvent these restrictions if it is worth doing so. Catch limits can be circumvented by landing fish at out-of-the-way docks and ports or through misreporting actual landings in document-based monitoring systems. However, vessel catch limits can have applications if the social issue of widespread adjustment out of the industry is thought to be more problematic for these communities than the economic and market inefficiencies that such programmes effectively institutionalize.

### *3.1.6 Individual effort quotas*

Individual effort quotas (IEQs) limit the fishing effort that a fishing craft can apply to a fishery and can be either transferable or non-transferable. Individuals have effort units – sometimes described in terms of a particular part of the fishing gear or other technological inputs such as allowable trawling time, time away from port, fishing days that the vessel can employ – which are used as approximate alternatives of percentages of a total allowable catch.

Non-transferable effort quotas often take the form of days-at-sea restrictions. These are effectively effort control measures that reduce capacity utilization rather than capacity. As with other effort controls, fishers are able to either modify their behavior or substitute other inputs over time, reducing the efficacy of the measure. Thus, while the number of

days fished or trawl time of a boat may remain constant, its fishing power can be increased by substituting other factor inputs in the production process for the fixed effort variable, thus causing the effective fishing effort to increase. As a result, fleet capacity increases over the long term, requiring constant re-adjustment of the total allowable effort. Further, they impose inefficiency onto the vessels, reducing their profitability.

In contrast, *transferable* effort quotas can have some benefits through creating incentives for self adjustment and may be useful in fisheries where determining total allowable catches might be problematic.[1] While individual transferable effort (ITE) systems do not address the property rights issue directly, they do exhibit some of the features of other rights-based measures and therefore fall between the categories of incentive blocking and incentive adjusting programmes. Moreover, the transferability of ITEs gives fishers the possibility of purchasing and selling their units, and this transferability allows for the consolidation of fishing activities and, possibly, also for the reduction of overcapacity. However, the difficulty with ITE systems is the fact that technology advances (sometimes referred to as "technology creep") will require constant readjustments of these units.

Transferable effort quotas have been introduced in the European trawl fisheries of the North Sea as part of a stock recovery programme (and not for capacity management, per se), and have also been used in the Faroe Islands as a main management measure.

## 3.2 Incentive-adjusting programmes

Perhaps the most familiar descriptions of so-called rights-based fisheries can be found in the category of what are increasingly being described as share systems, designated access systems of catch rights, or designated access privilege programs (DAPPs). Some are communal (issued to communities), whilst others can be either for individuals, individual companies, harvest cooperatives, or other appropriate entities.

### *3.2.1 Group fishing rights*

Community rights-based systems have been introduced in several countries with some success at controlling and reducing capacity.

Community Development Quota (CDQ) system instituted for Alaskan native communities is an example of an effective group fishing rights

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[1] Instead of ITQs, ITEs have been implemented in some fisheries with highly variable fish stocks – such as shrimp fisheries – owing to the technical problem of determining an appropriate total allowable catch each year.

programme that has reduced capacity substantially whilst empowering local fishing communities. The CDQs, now referred to as Community Fishing Quotas (CFQs), were set up in the 1980s to explicitly allocate shares of the Alaskan Pollock stocks to the remote communities of Alaska.

For group fishing rights systems to be effective, the group must be able have:

- institution building capability,
- restricted membership, and
- the ability to enforce rights and rules.[2]

### *3.2.2 Territorial use rights*

Territorial User Rights in Fisheries (TURFs), Management and Exploitation Areas for Benthic Resources (MEABRs), and Group Rights in Fisheries (GRFs) are rights-based systems that define who the participants are in a fishery in a particular area. Quite often these are communally-based and collective, although they may also be issued to individuals, single cooperatives, or single companies.

These systems represent another means to control capacity by causing fishers to behave as if property rights for a fishing ground exist. Access to, and use of, a particular fishing ground or site is restricted to a small group or an individual. This group or individual can determine how to harvest fish from the site.

### *3.2.3 Individual transferable quotas*

Individual transferable quotas (ITQs) and individual transferable share quotas (ITSQs) explicitly limit the fish that a fleet can harvest from a fishery and assign tradable shares of the total catch to the participants in the fishery. Under these approaches, resource ownership remains with the management authority, yet the transferable harvest rights give fishers a financial incentive to reduce capital investment and labour used in harvesting the fish stock in order to increase individual profitability. As a result, ITQs have been found to have been effective at managing capacity in the fisheries to which they have been applied because they are self-adjusting with regard to capacity.

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[2] Thus, the customary sea tenure (CST) or other customary tenure programmes that can also be considered as group fishing rights systems are at risk of not being respected by people outside the customary system – such as can happen when national, regional and global forces are brought to bear on the fishery and the CSTs are not reinforced by contemporary legal support.

ITQs have prompted objections regarding their use in the case of multi-cohort stocks, where there are concerns about high-grading catch (the discarding of less valuable cohorts when price is greatly affected by the size of the fish) or about discarding overquota catches, although several studies have found that overquota catch (and subsequent discarding) has been reduced in some fisheries as a result of ITQs. There are also concerns expressed about the possibility of a capacity cascade, displacement, or spillover of capacity that may occur if ITQs are sequentially adopted in a series of fisheries, and this concern is relevant when there is overcapacity in fisheries and entry into other fisheries is not already limited.

Nonetheless, and despite these concerns which are similarly relevant for many other management measures that are regularly applied, for the fisheries in which ITQs have been applied, substantial long-term declines in capacity have been observed.

One of the challenges for ITQs is in small-scale fisheries where there are potentially many boats, many landing sites, and localized fluctuations in stocks – situations in which group fishing rights may be more effective in terms of effectively monitoring and enforcing their rights.

*3.2.4 Taxes, royalties, rent collection and management cost recovery*

While a tax on landings is theoretically equivalent to ITQs in reducing capacity in a fishery, little empirical evidence of its actual impacts is available.

A serious problem in developing taxes is determining the optimal tax rate to apply to a fishery at a particular point in time. That is, the amount of capacity in a fishery depends upon the abundance of fish, the ex-vessel price, and the unit cost of fishing effort at each point in time. As costs, prices, and abundance fluctuate, capacity levels need to be adjusted by an appropriate tax adjusted on a timely basis.

With taxes, the governing authority has to determine the appropriate level of tax and has to decide when to change taxes to optimally control capacity. In contrast, with ITQs, these adjustments occur in the ITQ market automatically to determine the optimal capacity level.

In Asian countries, a tax on landings caused widespread protests among small-scale fishers and consumers who expected the taxes to result in higher prices.[3] Landings taxes have also been proposed in United States fisheries to

[3] FAO. 1998a. Report of the Technical Working Group on the Management of Fishing Capacity, La Jolla, USA, 15-18 April 1998. FAO Fisheries Report No. 586. Rome.

offset the costs of loans to fund industry financed vessel buyback programmes.

Royalties have a similar effect on reducing capacity, as they are effectively a form of tax. A fee paid per pound of fish landed or on quota holdings to a managing authority would theoretically reduce the ex-vessel price received by fishers, which would slow the rate of growth in harvest capacity in a fishery.

This method is in many countries for recovering rents in natural resource extraction activities (e.g. offshore oil leases or forestry "stumpage" charges) and could be employed in the management of fisheries.

A related mechanism that is not designed primarily for capacity management is management cost recovery charges. These internalize at least some of the costs imposed by the fishing fleet (e.g. enforcement, monitoring and research) that are otherwise borne by the broader community. Failure to recover these costs amounts to an effective subsidy of the industry, which itself contributes to some of the overcapacity.

**Appendix 4: Capacity utilization and efficiency: a primer**

Capacity utilization and efficiency are similar in concept as each represents the degree to which vessels are performing relative to other vessels using similar levels of inputs.[1] The capacity output of a vessel can be defined as the maximum level of output that it could be expected to produce under normal working conditions. Capacity output therefore takes into account periods of maintenance, poor weather, seasonal factors and other normal breaks in activity.

*Capacity utilization* is the degree to which the vessel is achieving its potential (capacity) output given its physical characteristics (i.e. fixed inputs such as size, engine power etc). Capacity underutilization may be a result of using fewer variable inputs (e.g. days fished, crew etc) that it otherwise could.

In contrast, *technical efficiency* is related to the difference between the actual and potential output given both fixed and variable input use. A vessel may be operating at below its capacity level due to underutilization of the fixed inputs, or the inefficient use of these inputs, or some combination of the two. Differences in efficiency may be related to differences in the skill of the skipper and crew, age of the vessel, differences in search and navigational aids, etc.

The two concepts are illustrated in Figure 4.1, in which a vessel of a given size is observed to be producing $O_o$ level of output as a result of using $V_o$ levels of inputs. If all inputs were fully utilized (i.e. using $V_c$ rather than $V_o$ variable inputs), and the vessel was operating at full efficiency, then the potential (capacity) output would be $O_c$. Even at the lower level of input usage, if the vessel was operating efficiently it would be expected to produce $O_e$ level of output. Hence, the difference $O_c$-$O_e$ is due to capacity underutilization; and the difference $O_e$-$O_o$ is due to inefficiency.

The depiction of underutilized capacity in Figure 4.1 differs from that of Figure A4.1 largely as the former represents an individual vessel, while the latter represents the industry as a whole. That is, the short run production frontier in Figure A4.1 represents the level of output produced by a given vessel, and at a given stock level. The vessel is underutilized if it is not operating at its maximum, based on normal working practices. At the industry level, total output could also be higher if all vessels operate at full capacity, or, as illustrated in Figure A4.1, the same level of output could be taken by fewer vessels operating at full capacity.

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[1] These concepts are different from that of overcapacity.

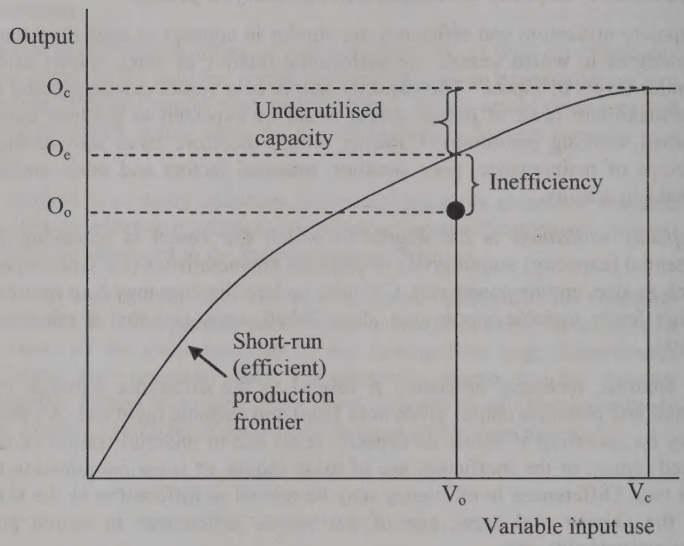


**Figure A4.1 Capacity underutilization and inefficiency**

The distinction between the concepts of inefficiency and underutilized capacity, while subtle, is important in terms of its consequence for fisheries management. A fleet that is inefficient but fully utilized would respond to management changes differently than one that is efficient but underutilized even though initial output levels may be similar.

Both capacity utilization and technical efficiency are relative measures. That is, the efficiency of one vessel, for example, is assessed against the other vessels in the fleet, the most efficient of which will be taken as perfectly efficient. It is conceivable that all vessels could be inefficient or underutilized relative to some idealized vessel, but if such a vessel does not appear in the data then the level of inefficiency or underutilized capacity will be underestimated.

These guidelines have been produced to supplement the FAO Code of Conduct for Responsible Fisheries and the International Plan of Action for the Management of Fishing Capacity (IPOA-Capacity). Because overcapacity is a key factor contributing to the decline of many of the world's fisheries, the IPOA-Capacity encourages States to manage fishing capacity so that it is commensurate with sustainable use of their fish stocks. The guidelines are intended to help stakeholders, fisheries managers and policy-makers in the development and implementation of National and Regional Plans of Action for the Management of Fishing Capacity. The guidelines outline the key concepts and techniques involved in monitoring, measuring and assessing capacity, and they provide information about the design and effects of different management programmes on fishing capacity. Given that the subject of managing fishing capacity is evolving, the guidelines are intended to be flexible and adaptable to changing circumstances or to new information. In addition, in order to present the capacity management process in all its complexity and diversity, the wording and structure of these guidelines do not follow strictly the language and the structure of the Code, but any differences in the terminology employed should not be understood as intending reinterpretation of the Code.

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